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SCIENTIFIC MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, PATTERN-MAKERS, FOUNDERS, AND MECHANICS GENERALLY.

VOL. X.—NO. 1. CLEVELAND, O., JANUARY 1, 1892. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. TERMS:—$1.50 A YEAR, SINGLE COPIES, 7 CENTS.

THE COLUMBIAN TOWER.

A company has been formed under the title of the American Tower Co., with a capital stock of $1,500,000, of which over $1,000,000 has already been spoken for, to build a tower for the World's Fair, which will cast the Eiffel in the shade. After long and careful study, designs have been prepared by the eminent engineer, George S. Morison, of Chicago, the designer and builder of some of America's most famous bridges. The Keystone Bridge Co. are ready to undertake its erection under the direction of George S. Morison, and give heavy bonds to complete it in time.

The general arrangement of the tower and the arrangement of the accommodations are modeled from those of the Eiffel Tower at Paris. The base of the tower is made approximately two-fifths of the hight; 200 feet above the base is placed the first platform, a large one to be occupied by promenades, restaurants and miscellaneous accommodations, this platform being high enough to command the best view of the entire exposition grounds and buildings. The second platform is placed 200 feet higher up than the first platform, though it will not be of so much importance; 500 feet higher up is the lantern, which is the principal point for distant views, and is surmounted by a lighthouse and flagstaff, the whole having a height of 165 feet. The flagstaff will be 1,120 feet above the ground. A side elevation is shown in the accompanying illustration, the small tower to the left giving a view from a distance, and the figure to the right showing the arrangement of the first platform.

While, however, the general arrangement is derived from that of the Eiffel Tower, the system of construction is necessarily of a very different character. The problem to be solved was to design a tower to be carried on the soft soil on which the city of Chicago is built, this soil being a fine sand which carries large weights perfectly well when they are properly distributed or supported, but has little power in itself to resist lateral thrusts.

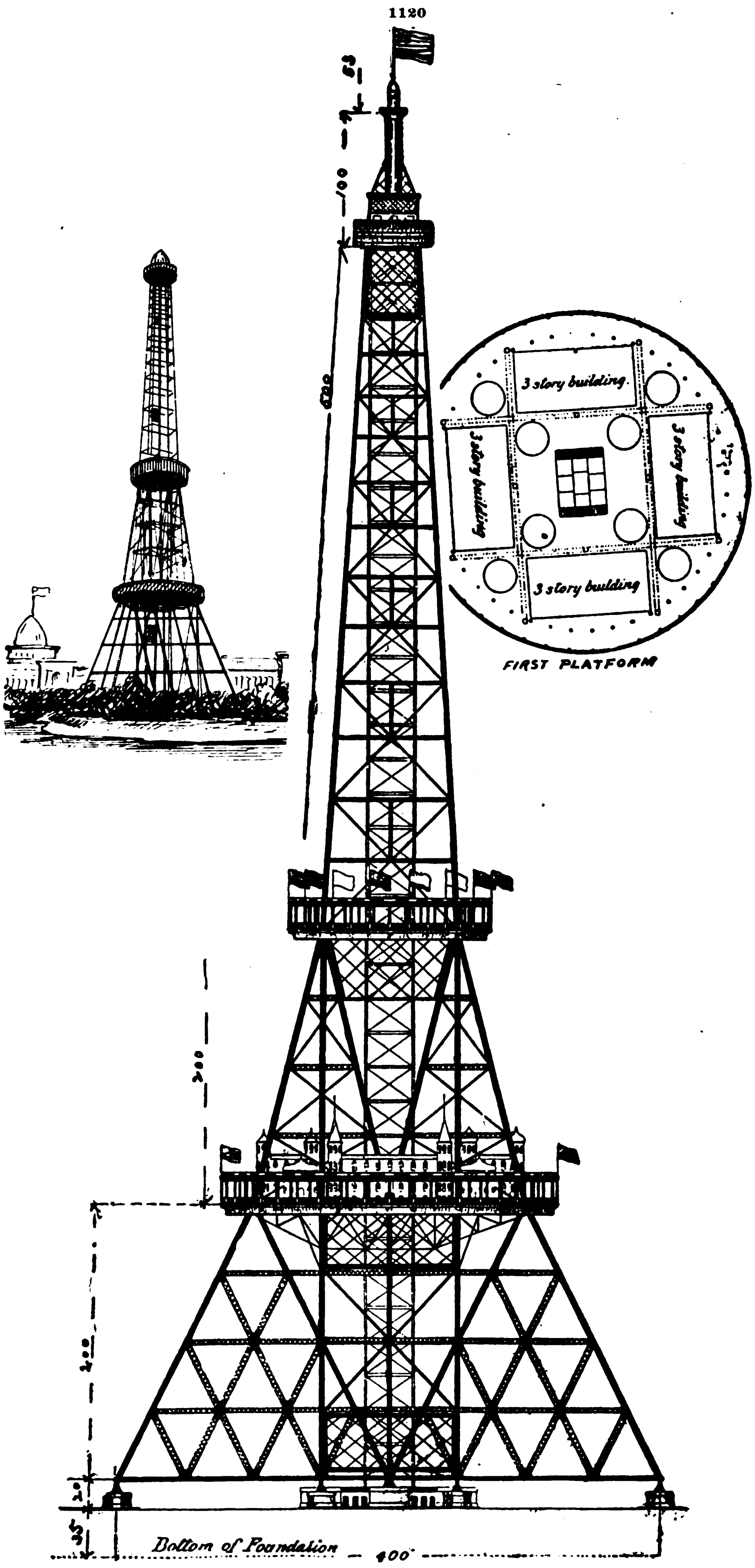
It is estimated that 5,000 people can be accommodated at one time on the colonade on the first landing; that 6,000 to 8,000 guests can be taken care of in the restaurants on the same landing; that the second landing can take care of 5,000 to 6,000 people, and that 1,200 to 1,500 people can be at the grand lookout. The four elevators to the first landing can handle 5,000 persons per hour; the two which go directly to the second landing can take care of 1,500, and the two fast elevators to the top are expected to carry 1,000 people, so that in all 7,500 people per hour can be transported. On this basis, the revenue, at 50 cents, 75 cents and $1.50 respectively, is estimated at $3,750,000 for 150 days, with an additional revenue of $250,000 for privileges, above expenses.

Besides these considerations of foundations, it was also necessary to design a tower which can be built in the shortest possible time and erected with a maximum speed. This will be assisted by the use of standard and merchantable sizes of steel, which will also decrease the cost. This made it necessary to confine the construction to right lines and square angles. This led to the selection of the plan adopted. The upper shaft from the lantern down to the second platform, is a square shaft battering from 40 feet square at the top to 100 feet square at the base, the entire weight being carried by the four corner posts which are stiffened by bracing in each of the four planes.

From the second platform to the first, each of the four sides of the upper shaft is continued downward in a vertical plane, the four planes intersecting each other on vertical lines 100 feet apart. Each of the four corner posts is, therefore, over one of the intersection lines of the planes, and the weight from each of the corner posts is distributed on four posts, two in each plane, these posts battering from each other with an inclination of one in four. The section of the tower, therefore, between the first and second platform consists of 16 posts, of which four are in each of the four planes, the interior posts coming together at the base, and the arrangement of the four posts being like an inverted W 300 feet high and 200 feet wide. The shape, therefore, of the tower at the level of the first platform is cruciform, measuring 200 feet in each direction and 100 feet across each arm. The posts are braced together at intervals of 50 feet in the four planes.

Below the first platform the weight from the eight interior posts is carried directly to the foundation by vertical posts, while the weight from the ex-

[Continued on page 5.]



COLUMBIAN TOWER FOR WORLD'S FAIR—SIDE ELEVATION.

THE DEVELOPMENT OF THE STEAM ENGINE.—II.

BY PROF. R. H. THURSTON.

Newcomen's Engine.

The performance of the Savery engine was thus evidently unsatisfactory, as judged from the modern standpoint; yet, as the first machine applying natural forces to a great task, and for the first time accomplishing it, it was a grand success. The operation of deep mines had become impracticable where water was met with in any considerable quantity, and, in some cases, hundreds of horses had been kept employed, at enormous and even fatal expense, to keep the lower levels in working. These were displaced by steam and the Savery engine, and mines which must otherwise have been abandoned were once more made profitable.

The defects of this class of engines were nevertheless great. Their enormous consumption of fuel was one serious difficulty everywhere except in the coal districts; their heavy pressures needed at deep shafts and for high lifts gave rise to dangers which threatened constantly both life and property when, as was very usual, the workmanship of the "forcing vessel" was defective. In fact, the invention of the Savery engine was introductory to the steam-boiler explosion, several of the boilers exploding wheil at work and doing some damage. This new and intimidating experience, and the evident wastefulness of the machine, led mechanics, very soon, to study the problem anew with a view to improvement in these respects; its extravagant consumption of fuel, the inconvenient necessity of placing it near the bottom of the mine to be drained, and of putting in several for successive lifts where the depth was considerable, and, especially, the risk which its use with high pressures involved, even in its best form, had considerably retarded its introduction, and it therefore came into use very slowly, notwithstanding its superiority over horse-power.

Many years after Savery's death, in 1774, Smeaton made the first duty-trials of engines of this kind. He found that an engine having a cylindrical receiver 16 inches in diameter and 22 feet high, discharging the water raised 14 feet above the surface of the water in the well, making 12 strokes, and raising 100 cubic feet per minute, developed 2⅔ horse-power, and consumed 3 hundredweight of coals in four hours. Its duty was, therefore, 5,250,000 pounds raised one foot per bushel of 84 pounds of coals, or 62,500 "foot-pounds" of work per pound of fuel. An engine of slightly greater size gave a duty about five per cent greater.

The first important step taken towards remedying the defects of Savery's machine was taken by Thomas Newcomen and John Cawley, or Calley, two mechanics of the town of Dartmouth, Devonshire, England, who produced what has been known as the atmospheric or Newcomen engine. Newcomen was a blacksmith, and Cawley a glazier and plumber. It has been stated that a visit to Cornwall, where they witnessed the working of a Savery engine, first turned their attention to the subject; but a friend of Savery has stated that Newcomen was as early with his general plans as Savery. After some discussion with Cawley, Newcomen entered into correrpondence with Dr. Hooke, proposing a steam engine, to consist of a steam cylinder containing a piston similar to those of Huyghens's and Papin's engines, and driving a separate pump, similar to those generally in use where water was raised by horse or wind power. Dr. Hooke advised and argued strongly against their plan; but, fortunately, the obstinate belief of the unlearned mechanics was not overpowered by the disquisition of their distinguished correspondent, and Newcomen and Cawley attempted an engine on their peculiar plan.

This succeeded so well as to induce them to continue their labors, and in 1705 to patent—in combination with Savery, who held the right of surface condensation, and who induced them to allow him an interest with them—an engine combining a steam-cylinder and piston, surface-condensation, and a separate boiler and separate pumps. In the atmospheric engine as first designed, the slow process of condensation by the application of the condensing water to the exterior of the cylinder to produce the vacuum caused the strokes of the engine to take place at very long intervals. An improvement was, however, soon affected which immensely increased this rapidity of condensation. A jet of water was thrown directly *into* the cylinder, thus effecting for the Newcomen engine what Desaguliers had done for the Savery engine. As thus improved, the Newcomen engine is shown in Fig. 4.

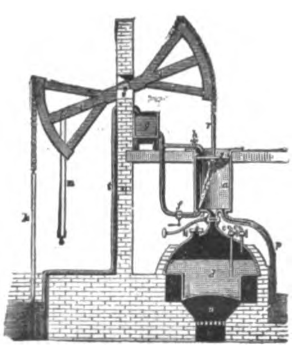


FIG 4.—NEWCOMEN'S ENGINE, A. D. 1705.

Here *d* is the boiler. Steam passes from it through the cock *d*, and up into the cylinder *a*, equilibrating the pressure of the atmosphere, and allowing the heavy pump rod *k* to fall, and, by its greater weight, acting through the beam *i i*, to raise the piston *s* to the position shown. The cock *d* being shut off, *f* is then opened, and a jet of water from the reservoir *s* enters the cylinder, producing the vacuum by the condensation of the steam. The pressure of the air above the piston now forces it down, again raising the pump-rods, and thus the engine works on indefinitely. The pipe *h* is used for the purpose of keeping the upper side of the piston covered with water, to prevent air-leaks—a device of Newcomen. Two gauge-cocks, *c*, *c*, and a savety-valve, *N*, are represented in the figure, but it will be noticed that the latter is quite different from the now usual form. Here, the pressure used was hardly greater than that of the atmosphere, and the weight of the valve itself was ordinarily sufficient to keep it down. The rod *m* was intended to carry a counter-weight when needed. The condensing water, together with the water of condensation, flows off through the open pipe *p*.

Newcomen's first engine made six or eight strokes a minute; the later and improved engines made ten or twelve.

The steam-engine had now assumed a form that somewhat resembled the modern machine. An important defect still existed in the necessity of keeping an attendant by the engine to open and shut the cocks. A bright boy, however, Humphrey Potter, to whom was assigned this duty on a Newcomen engine, in 1713 contrived what he called a *scoggan*—a catch rigged with a cord from the beam overhead—which performed the work for him. The boy, thus making the operation of the valve-gear automatic, increased the speed of the engine to fifteen or sixteen strokes a minute, and gave it a regularity and certainty of action that could only be obtained by such an adjustment of its valves.

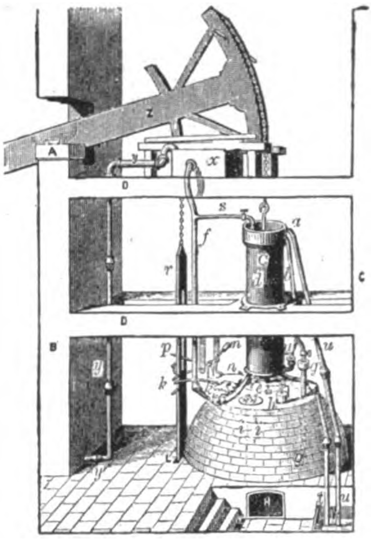


FIG. 5.—BEIGHTON'S VALVE-GEAR, A. D. 1718.

This ingenious young mechanic afterward became a skillful workman and an excellent engineer, and went abroad on the Continent, where he erected several fine engines. Potter's rude valve-gear was soon improved by Henry Beighton, and a new device was applied to an engine which that talented engineer erected at Newcastle-on-Tyne, in 1718, in which engine he substituted substantial materials for Potter's unmechanical arrangement of cords, as seen in Fig. 5.

In this sketch *r* is a plug-tree, plug-rod, or plug-frame, as it is variously called, suspended from the great beam with which it rises and falls, bringing the pins *p* and *k*, at the proper moment, in contact with the handles *k k* and *n n* of the valves, moving them in the proper direction and to the proper extent. A lever safety-valve is here used, at the suggestion, it is said, of Desaguliers. The piston was packed with leather or with rope, and lubricated with tallow.

In illustration of the application of the Newcomen engine to the drainage of mines, Farey describes a small machine, of which the pump is 8″ in diameter, and the lift 162 feet. The column of water to be raised weighed 3,535 pounds. The steam piston was made two feet in diameter, giving an area of 452 square inches. The net working pressure was assumed at 10¾ pounds per square inch; the temperature of the water of condensation and of uncondensed vapor after the entrance of the injection water being usually about 150° Fahr. This gave an excess of pressure on the steam side of 1,324 pounds, the total pressure on the piston being 4,859 pounds. One-half of this excess is counterweighted by the pump-rods, and by weight on that end of the beam; and the weight, 662 pounds, acting on each side alternately as a surplus, produced the requisite rapidity of movement of the machine. This engine was said to make 15 strokes per minute, giving a speed of piston of 75 feet per minute, and the power exerted usefully was equivalent to 265,125 pounds raised one foot high per minute. As the horse-power is equivalent to 33,000 "foot pounds" per minute, the engine was of $\frac{265125}{33000} = 8.034$—almost exactly 8 horse-power.

It is instructive to contrast this estimate with that made for a Savery engine doing the same work. The latter would have raised the water about 26 feet in its "suction pipe," and would then have forced it, by the direct pressure of steam, the remaining distance of 136 feet; and the steam pressure required would have been nearly 60 pounds per square inch. With this high temperature and pressure, the waste of steam by condensation in the forcing vessels would have been so great that it would have compelled the adoption of two engines of considerable size, each lifting the water one-half the height, and using steam of about 25 pounds pressure.

Further improvements were effected in the Newcomen engine by several engineers, and particularly by Smeaton, and it soon came into quite extensive use in all of the mining districts of Great Britain, and it also became generally known upon the Continent of Europe. Its greater economy of fuel as compared with the Savery engine in its best form, its greater safety—a consequence of the low, steam-pressure adopted—and its greater working capacity, gave it such manifest superiority that its adoption took place quite rapidly, and it continued in general use in some districts where fuel was cheap up to a very recent date. Some of these engines are even now in existence. From about 1758 to the time of the introduction of the Watt engine, this was the machine in almost universal use for raising large quantities of water.—[From "A Manual of the Steam Engine," by Prof. R. H. Thurston. Part 1st. Published by John Wiley & Sons, 53 E. 10st, N. Y. 2nd part ready about July.

(To be continued.)

STEAM pipes have been made in England from the ramie fibre. In carrying this out the material is subjected to tremendous hydraulic pressure, and, having the property of being unaffected by moisture, will neither shrink nor swell, besides being a non-conductor of heat. These pipes are said to have twice the tensile strength of steel pipes.

AN Italian engineer has originated a system by which he proposes to utilize the power of trains rnnning down grade; that is, he has devised a machine for compressing air as the train goes down, which can be used to actuate a motor, and to assist the locomotive on up grades.

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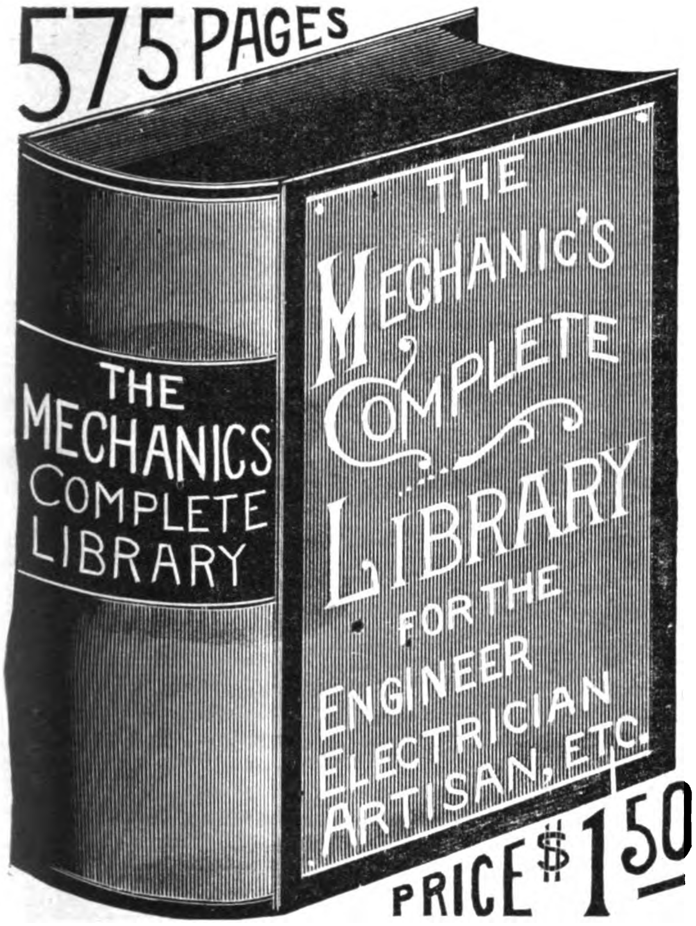
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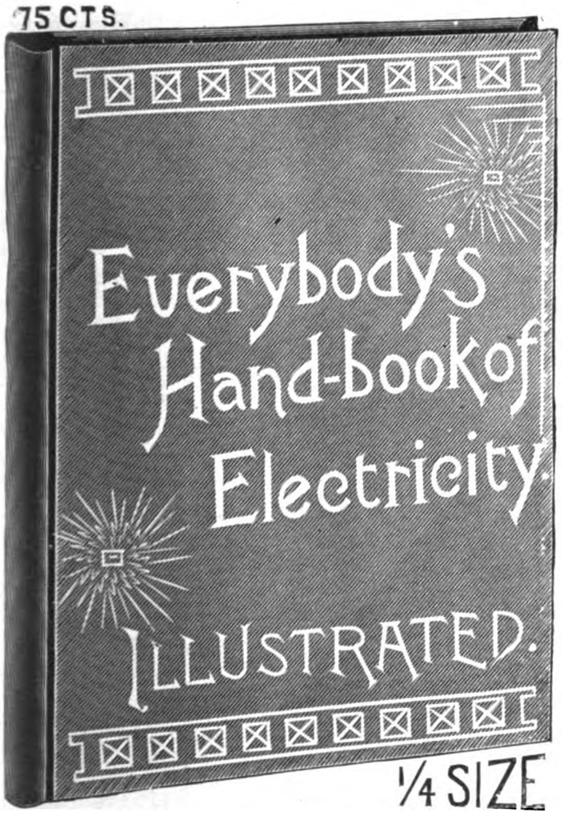
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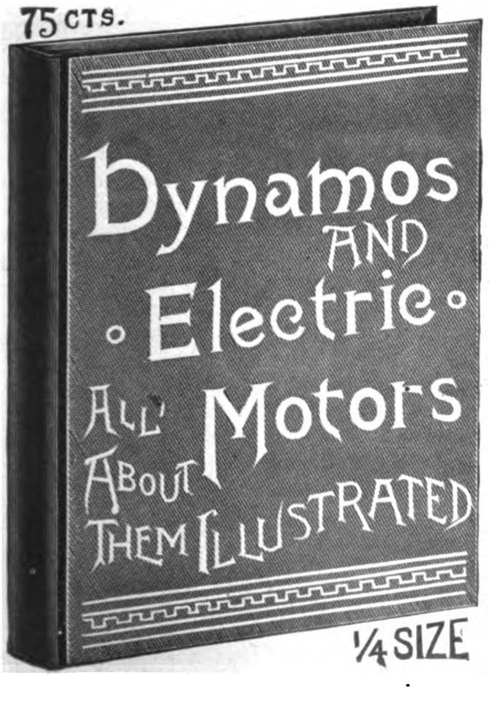

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SEE PARTIAL LIST OF CONTENTS ON PAGE 14.

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It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience or experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

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A VALUABLE LESSON.

Every week we hear of some short term "beneficial" order suspending payments and going the way of all things that offer something for nothing. This was what we predicted over a year ago.

When we denounced these institutions as frauds and advised mechanics to steer clear of them, we offended certain of our readers who had been persuaded to start "lodges" and enlist recruits from the shops in which they were employed. These men probably believed that the slick agents who had induced them to become members had given a truthful account of how the thing worked, and believed that the promises made could and would be fulfilled. They felt the effects of our words of caution, and some were very wrath. One subscriber had raised a club for our paper, but was so incensed at our course and its results upon his prospective "lodge," that he refused to send in the new subscribers. Others cancelled their subscriptions and induced more do likewise. We regretted to lose their patronage, but knowing that it was our duty to tell our readers the plain truth in regard to these institutions, we continued to warn mechanics to stay out. There are none now who will contend that the "beneficial" orders are legitimate, straightforward concerns.

If this should chance to be read by any of the gentlemen who fancied themselves injured, we hope that they will give us credit for acting for the best interests of our readers. They should also learn from this experience that a mechanical paper is not apt to attack any institution or thing without cause, for they have much to lose by unjust criticism and nothing to gain.

THE CITY AND THE GAS COMPANIES.

The war for the reduction of the price of gas to 60 cents per thousand cubic feet is still going on between the City of Cleveland and its two gas companies. There is a long and better contest ahead, but meanwhile the people are paying the old price for gas, which is everywhere admitted to be greatly inferior to the quality served before the agitation commenced.

It is altogether likely that the gas companies will win. Their tactics are to fight it off in the courts until the official term of the present council expires, when a gigantic effort will be made to elect, by wholesale corruption, a council that will be subservient to them, and through which they will repeal the ordinance that the city is endeavoring to enforce.

It has been shown that the stock of the companies is nine-tenths water, and that dividends of 150 per cent. per annum are paid on the actual capital. It would seem that if the American people are as well fitted for self government as they claim to be, that a municipality, on such a showing, could in some way accomplish its purpose of getting gas down to a reasonable price. But unless the people become thoroughly aroused and determined, their servants will continue to be their masters.

WORM AND WORM WHEEL—SCREW SLOTS.

BY J. J. SAND.

There is a great difference between the worm and worm wheel in general use and the kind that is perfectly shaped, and the reason is that it is much more convenient to cut the worm in the lathe by use of lead screw than it is to make a hob for producing the worm. But in many places where great duty is placed on this type of gear the hobbed worm will give the only satisfactory results.

The ordinary practice of producing the worm and wheel requires only a hob for cutting the wheel. This hob is produced the same as the worm. The wheel tooth is of a form that takes bearing only on a very small area, and hence is not adapted to working under heavy strain, and it is not durable. Then another trouble with this type is that the depth of tooth can not be sufficient on wheels of small diameter. In the correctly formed worm and wheel the wearing surface is of greater area; instead of the contact between the worm and wheel being only on lines it covers the whole face and depth of the tooth and gives a bearing as perfect as a nut on a screw.

The extra cost of making a hob for producing the worm is not great, considering the increased durability and strength of the worm and wheel. Another feature of this form is that any depth of tooth may be used.

All machinists have probably seen this same thing shown up in books on gearing, but it is very seldom that we have had the pleasure of seeing it put to use and shown to be of practical value.

A worm and wheel made by use of hobs for each will outlast at least ten of those in common use, and should be recommended for all places requiring great service, either of high speed or low speed and heavy strain.

This form of worm and wheel is now being used by a Philadelphia concern that builds elevators and it is needless to say that the results are the best.

There is no point of greater importance in making a machine look presentable for sale than the shape of the slots in the screw heads. If the screws have been set up by use of an improperly fitting screw-driver, the slot will show it, particularly if the screw head is soft. To overcome this trouble it is necessary for each workman to have at a convenient place an assortment of screw-drivers, one for each width of slot. It is not necessary for the width of the blade to be exactly the same as the diameter of the screw head, but it should fit the sides of the slot perfectly. To reduce the number of screw-drivers required, it is advisable to make the width of blade equal to the diameter of the smallest screw head using the width of slot of each screw-driver. Also, to reduce to the smallest possible number the widths of slots used.

Many shops have gone so far as standardizing screw slots and screw-drivers, but have omitted one very important point; that is, ordinary means for keeping the screw-drivers to the standard. Screw-drivers will break and men will re-grind them, and generally to fit a particular screw which may be a trifle "off." To prevent this and give each man an ever present guide to correct size for re-grinding the blade when broken, the handle should be marked with figures indicating the exact dimensions of the blade. For instance, if a workman had three screw drivers the sizes could read $\frac{3}{8}$x$\frac{1}{16}$, $\frac{5}{8}$x$\frac{3}{32}$, and $\frac{7}{8}$x$\frac{1}{8}$, or any other sizes that would best suit the screws used.

The handles should also bear the workman's tool room number, to prevent loss or exchange. The shank of the blade should be square and nearly the full width of the blade, and, instead of being pointed or reduced, it is best to let it into the handle full size and nearly two thirds of the length of the handle. In order to do this it is necessary to drill the handle a trifle larger than the size of the shank and by use of three or four broaches bring the hole to the correct form.

A rack should be provided back of each bench for holding each set of screw-drivers and the holes in the rack should fit close enough to prevent the misplacing of the drivers. The above scheme is now in operation in a tool building concern in New England and it is giving excellent satisfaction. The screw-drivers are made and furnished by the Company and each bears the imprint of the company.

Description of a Great Dam.

Official details of the great dam at Beetaloo, Australia, correct some of the previously published statements and figures, and the immensity of such a piece of engineering work may well challenge comparison with anything of the kind in that part of the world. The structure is of concrete, 110 feet high from the bed of the creek to the top of the dam, and 580 feet long, being curved in plan to a radius of about 1,400 feet; the width of the top is 14 feet, the profile of the section being designed in accordance with Rankine's rules, and the width of the section at the foundation is 110 feet; the crest of the by-wash, which is 200 feet wide, is five feet below the crest of the dam; and the reservoir behind the dam at its full one and one-fourth miles long, with an average width of eight chains. The capacity, under these conditions, is 800,000,000 gallons, for the supply of a district covering an area of 1,700 square miles, including eight separate townships, etc. The quantity of concrete used was 60,000 cubic yards, the net time occupied in construction being about two and one-half years. Special machinery was used for mixing the concrete and depositing it in place, and the whole work is regarded as a most creditable achievement.

Literary Note.

"Part 6, Maxims and Instructions for the Boiler Room," by Prof. N. Hawkins, is now issued. Descriptive catalogue free. Theo. Audel & Co., 91 Liberty street, N. Y. John W. Sanderson, of Clayton, N. Y., writes, Sept. 11, "referring to above series," your book is worth its weight in gold, to the engineer and fireman.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(294.) R. I. H——l, Butler, Mo., writes: "As there has been a dispute about the distance traveled by the crank pin and piston rod of an engine, we have concluded to leave it to you to decide the question. There are some engineers who claim that the crank pin of an engine moves six times as far while the piston is traveling the first inch of the stroke as while it is making the middle inch. Also that the crank pin travels less while the piston is making the last inch of the stroke than it does while it is making the first inch of the stroke. When the crank is on a dead center the piston is at the end of the stroke. Now move the crank forward until the piston moves one inch and I find (by my calculation) the crank pin moves 2.9062 inches. Then move the crank forward until the piston gets to the middle inch, then move the crank forward again until the piston travels the middle inch, and I find that while the piston is traveling that middle inch the crank pin travels 1.0125 inches. I also find that while the piston is traveling the last inch of the forward stroke, the crank pin travels 3.6354 inches. Now if 2.9062 inches are six times 1.0125 inches, and 3.6354 inches is less than 2.9062 inches, it is something I can't comprehend. My calculations have been made for a ten-inch stroke and a 24-inch connecting rod. Am I right? If not explain it." *A.*—You are correct. This difference is caused by the angularity of the connecting rod, but the difference of the distance traveled by the crank pin compared with the piston varies with the length of the rod.

(295.) C. B S, New Orleans, La., asks: "When you notice the jar or force of the stroke of the engine in the boiler room, what does it signify?" *A.*—When you can feel the pulsations of an engine in the boiler room, it is a good sign that the boiler is too small.

(296.) A Subscriber, Brooklyn, N. Y., asks: "What dressing, easy to get, would you recommend for keeping tools from rusting?" *A.*—Vaseline or petroleum, I think, is the best thing you can use to keep tools from rusting.

(297.) "Fireman," Cohoes, N. Y., asks: "What is the limit of speed, for safety, on a cast iron fly-wheel?" *A.*—We have answered this question several times. A cast iron fly-wheel should not be given a greater run of speed than 80 feet per second to be perfectly safe.

(298.) John M——n, Cleveland, O., asks: "Speaking of heating surface of a boiler, how do you ascertain the same on a tubular boiler? Is it the outside or inside?" *A.*—To determine the heating service in a horizontal tubular boiler, measure the circumference of that part of the shell with which the fire comes in contact in feet, and multiply by the length of the boiler in feet. Then multiply the length of the tubes by their circumference in feet, and this by the number of tubes, will give the number of square feet of heating service in the boiler.

(299.) J. M——s, Auburn, N. Y., asks: "At what temperature will good kerosene oil, 150 degrees fire test, vaporize?" *A.*—Good kerosene oil boils at about 400 degrees Fahr. This is 150 degrees fire test. At this temperature it is completely vaporized. One volume of oil makes about 150 volumes of vapor.

(300.) J. R. Q——l, Troy, N. Y., writes: "The joints of my steam pipe leak, and I have never been able to get one that would stand. Can you recommend a cement that will stand?" *A.*—Steam pipe cement for use when the temperature is not too high may be made with linseed oil and varnish ground in equal parts of white lead and oxide of magnesia. Smear on a gasket made of fly-screen.

(301.) W. A. F——r, Port Huron, Mich., asks: "How can I calculate the number of passengers a steam launch will carry?" *A.*—To find the number of persons a steam launch will carry on smooth water, multiply the length of the boat by its beam in feet and divide by 6. The result will be the number of persons it will carry.

(302.) Young Engineer, Oshkosh, Wis., asks: 1. "What is the increased friction, in a slide valve engine, which an unbalanced condition will cause? 2. What is the safety valve area per square foot of grate surface?" *A.*—1. The friction of an unbalanced slide valve is about 20 per cent. of the total friction of the engine. But if the slide valve is carefully balanced its friction is reduced to about 2½ per cent. 2. For an engine working under an ordinary pressure, there should be one square inch of safety valve area for each 1¾ feet of grate surface. The supervising inspector of steam vessels prescribes no less than one square inch for every two square feet of grate surface for level valves, and their seats must have an inclination of not less than 45 degrees of center line of their axis.

(303.) George D——n, Pittsburgh, Pa., asks: "How is the thickness of a copper pipe ascertained?" *A.*—The thickness of a copper pipe is found by multiplying the diameter of the pipe by the pressure in pounds per square inch it will have to sustain, and divide the product by 4,000. The quotient obtained will be the thickness required in inches or part of an inch.

(304.) "New Subscriber," Jackson, Mich., writes: "I have had trouble with japanning, and would like to know how to make a good dryer." *A.*—To make Japan dryer take 3½ pounds each of lead and litharge and ¾ pound of raw umber, ¾ pound sugar of lead pulverized. Mix these together and add five gallons of linseed oil. Then simmer them over a steady fire for two or three hours. Remove the kettle and when the oil is cooled considerably, add five gallons of spirits of turpentine. Having stirred the mixture thoroughly, let it remain without disturbance for 10 or 12 hours and pour it off carefully.

(305.) J. B——n, Dover, N. H., writes: "I would like to have you suggest a way to make a mortar for varied and severe weather." *A.*—A mortar that will stand all sorts of weather is made of one bushel of unslacked lime and three bushels of sharp clean sand, one pound of pulverized alum, and one pint of linseed oil.

(306.) B. W., Elmira, N. Y., writes: "I have always thought that when an engine cut, from improper lubrication, that it indicated bad oil, and that to use more would not help matters. A friend says that if there is cutting more oil will prevent it, always. But if a person is using oil that honey-combs the valve-seat he does not like to use much of it. I have heard that mineral oil is not a good thing in the cylinder. What do you think?" *A.*—Cylinder oil containing mineral oil is not apt to cause honey-combing on the valve seat and cylinder. When the piston has insufficient bearing surface the pressure is so great there sometimes is not enough oil used to prevent cutting. If one has bad oil he should procure better, and use sufficient to lubricate properly.

(307.) R. M. L——x, Brattleboro, Vt., writes: "Will you be kind enough to tell me the best way to grind a copper roll so that I can get it perfectly round and straight? I have tried it with emery wheels, but it doesn't do it very well. It grinds away the wheel, but doesn't seem to make the roll round or straight. The roll is 4" diameter and 35 feet long, with heads on each end. I used a stream of soda water. Would it have been better to have turned the roll first? I straightened as true as I could before grinding." *A.*—By all means, plug up the tube and turn it in the lathe. Finish it with a file, then polish with two blocks of wood shaped the same as tube, using emery between them.

THE COLUMBIAN TOWER.

[Continued from 1st page.]

terior posts is carried down on the same principal that the weight from the four posts of the upper shaft is carried—that is, by two equally inclined posts from each point. To bring these posts together at the center it was necessary to double the batter, making it one in two instead of one in four. Each plane, therefore, of the lower 200 feet of the tower becomes an inverted W, 200 feet high and 400 feet wide on the base, with a vertical member in the center. The members of this plane are stiffened by bracing placed every 50 feet. The base of the tower is also cruciform, each arm being 400 feet long and 100 feet wide.

The weight of the structural portions of the tower above the masonry foundations is about 7,000 tons. To this is to be added 2,000 tons for the weights of floors and buildings, and 2,000 tons more for live load, making a total weight of 11,000 tons, of which less than one-fifth is variable. A grain elevator of 1,000,000 bushels capacity—and there are much larger elevators than this in Chicago—weighs, when full of grain, at least 50,000 tons, of which more than one-half is variable, besides which it exposes a large flat surface to the wind, and in all respects is subject to much greater disturbing elements than the tower.

The foundation work will comprise eight outlying piers supporting the exterior bearings of the tower, and the central pier, which supports the center bearing. The general principle adopted for these foundations is that of concrete piers resting on piles. The weight per pile will be limited to from 10 to 15 tons, according to observations to be made when work is actually begun. These weights are without any allowance for the bearing on the ground surface between the piles. If the piles were entirely omitted the weight on the surface would be from 1¼ to 1¾ tons per square foot. The concrete foundation will begin two feet below mean water in Lake Michigan, and the pile would extend up three feet into the matrix of concrete. All concrete will be first-class Portland cement concrete. The central pier will contain 7,500 yards of concrete and be supported on 1,600 piles. Each of the outlying piers will contain 700 cubic yards of concrete and be supported by 185 piles.

Above the concrete foundation, which will be about level with the graded surface of the ground, will be built separate piers, one on each of the outlying foundations and four on the central foundation. These piers will be of limestone with heartings of Portland cement concrete, the piers on the central foundation being 30 feet square and 14 feet high, and those on each of the outlying foundations 20 feet in diameter and 11 feet high. The total amount of masonry and concrete in all the foundations is somewhat more than 15,000 cubic yards. The details of the proposed tower, published in the *Iron Age*, have been useful in preparing this description and the illustrations.

New Band-sawing Machine.

Among the recent mechanical novelties of a practical character brought forward is a band-sawing machine, especially adapted to the use of wheel and carriage makers, chair and car shop work, where an inexpensive machine for heavy duty is wanted; the machine carries a saw from one-fourth to two inches wide, and has leather-covered saw pulleys of forty-two inches diameter, the table being thirty-nine by thirty-three inches, made of hardwood strips, and capable of being elevated to an angle of twenty-seven degrees. Attention has also been directed, lately, to a remarkably light and compact form of rolled steel or iron columns, consisting of two I beams bent longitudinally at right angles and bolted together with a small I beam between them. This kind of a column is claimed to possess various advantages over the solid ones, one of these being the judicious distribution of the iron where greater degrees of strength are essential, but which is not recognized in the solid; another being the readiness with which it may be painted to prevent rusting, owing to the fact that the surface is nearly all exposed.

Electrical

☞ *The Electrical Lessons recently printed, one of which gave directions for making a dynamo, will soon be completed, when the whole series will be published in a neat volume with paper covers. Every one subscribing after December 1st, 1891, will receive a copy free. This series constitutes the simplest and best instruction for beginners we have yet seen.*

Electrical Lessons for Machinists and Engineers.—X.

ELECTRO-PLATING—NICKEL-PLATING.

Electro-plating is an art requiring careful, patient and practical experience in order to do creditable work. Many have engaged in the business under the impression that practical experience was unnecessary—that with the aid of books on the subject *any one* could do good work. Experience has proven the contrary. Good work, or any work at all, cannot be done without some practical personal experience and the knowledge of the chemicals used in this very interesting art, while at the same time, with practical instruction (in contradistinction to theoretical, which most books deal in), followed by careful and intelligent experiments, one not familiar with electro-plating may do fairly good work.

The writer of these articles has endeavored to make use of only such terms as will be easily understood, and, at the same time, enable the operator to successfully carry out the instructions herein imparted. By carefully following the instructions, a person of ordinary intelligence can do creditable work, as practical workshop experience only is given.

All work must be *chemically* clean before being placed in the plating bath, absolute cleanliness must be observed—otherwise failure is certain. As all operations are necessarily rapid, the plater should see that all material, tools, etc., are within easy and instant reach, as so little a thing as a layer of air frequently causes a failure. All connections from the dynamo should be carefully cleaned, also the rods on the plating tanks must be kept bright and clean. As this article deals entirely with the plating room, it is not necessary to describe the process of preparing the work to be plated, as that is a trade not directly connected with the plating room.

Nickel being in more general use, we will describe that process first. The proportions of a well saturated nickel solutions are three-quarters of a pound of sulphate of nickel and ammonia, dissolved in one gallon of water. All the apparatus required to make a nickel solution in large quantities are a clean whisky barrel, a wooden pitch-lined tank of the size desired, and a piece of ¾" rubber hose. Suppose the quantity desired is 50 gallons, then 25 gallons of clean water is placed in the barrel, to which is added 38 pounds of the nickel sulphate (the large crystals being previously crushed). The rubber hose is attached to a valve of the steam boiler, and the free end is inserted into the barrel, the steam is turned on and the water is brought to a boil, and continued until the nickel crystals are all dissolved. After cooling, this solution is poured or strained through muslin stretched over the tank, and enough water added to make 50 gallons. The color of this solution is a deep, emerald green. On each side of the tank are placed two brass or copper rods about ⅝" thick, and of sufficient length to reach 2" over the ends of the tank. On these rods are hung—by means of stout copper hooks—nickel anodes, or plates—the lower parts of which hang into the solution—three on each side. The size of these anodes is 6"x12" and about ½" thick. The two rods are connected at one end, and one end of one rod is connected by a copper wire to the large binding post on the dynamo. Another rod—of the same dimensions as the anode bars, is laid down the center of the tank and connected with a wire running to a large binding post on the dynamo. Everything is now in shape to commence plating.

It is well to say here that it is frequently necessary to reduce the current from the dynamo to accommodate the amount of work in the solution. This is accomplished by placing a resistance switch between the dynamo and the plating tank on the positive wire. By this means the quantity of current can be controlled to any desired amount.

The solution sometimes becomes impaired by copper having dissolved off the slinging wires. This copper can be worked out, but the quickest way is to dissolve about one pound of boracic acid in hot water, and add it to the solution at night. Stir up the solution well, and it will regain its color. At times iron will permeate the solution. This iron is precipitated by means of three pounds of salt dissolved in hot water and put in at night. The best thing for the plater is to be sure and *not* allow anything of iron or copper to lie in the solution without a current passing through. By carefully observing this rule you will not be under the necessity of doctoring your solution.

A quantity of solution should be kept ready and added to that in the tank from time to time to replace the loss by evaporation and dripping.

When the goods (iron or steel) come from the polishing-room they are strung on wires or hooks (as most convenient), and are then placed in a boiling hot solution twenty minutes. This solution is composed of one-half pound caustic potash or soda to one gallon of water, and is used to remove grease from the article to be plated. The goods are then removed from this potash water and rinsed in cold water—to remove the potash—and placed on a bench and scoured lightly with a stiff brush and powdered pumice, moistened with water. The article is again plunged into cold water and brushed to remove all traces of the pumice, and then hung in the plating solution from the center bar. For an ordinary plate fifteen minutes immersion is sufficient, but for a really good coating of nickel from one-half to three-quarters of an hour will suffice. If the work is first copper plated it will cause the nickel coating to be more lasting and durable. In cleaning brass work for plating, pumice must not be used as that will scratch and deface a delicately polished brass surface and cause an unfinished looking job. Brass work is wired and potashed, the same as iron, and when taken from the potash water and rinsed, it is dipped in a strong cyanide solution of three ounces cyanide of potash to the gallon of water, and then lightly and carefully cleaned with a sponge moistened with a little cyanide water and whiting. This removes any surplus grease not dissolved by the potash water. The article is again rinsed in cold water and placed in the bath where it remains twenty minutes to half an hour; it is then removed from the bath, rinsed in cold water and then plunged into hot water, swung in the air a moment and then taken to the finishing or buffing room.

The whole operation is very simple, and easily learned by any one having the time and inclination. In this little article we have narrowed everything down to actual every-day practice. In our next issue we will describe silver plating and all about it.

CLOUGH.

LETTERS FROM M. C. MAC.—I.

Series of "New and Easy Ways of Doing Work."

In responding to the editor's invitation to write some letters on "New and Easy Ways of Doing Work in the Machine Shop," for the SCIENTIFIC MACHINIST, I will call the reader's attention to the fact that there is no "soldier" connected with it that I can can find. Take it as I will, it has every appearance of a hard job. Just look at the combination for a minute, "*new* and *easy*." All usual methods of doing a job are barred. The first impulse is to kick, but as the editor is certainly justified in giving out this kind of a job, in fact, just the kind of work he wants done, to kick under such circumstances would be cowardly. We are born to work, rather than to kick, although kicking, like everything else, has its place, and is by no means to be despised. For instance, Thomas Jefferson kicked against "taxation without representation," which resulted in the independence of the United States, a country where everyone can enjoy the same privileges, whether he pays taxes or not. There are numberless such cases that would be a pleasure to speak of, but I desist.

"*New* and *Easy*." It appears to me that the editor struck the key-note when he wrote those three little words. It is right in the line of progressive thought in every vocation. In every industry it is of the first importance. It is the very foundation of our patent system, which, though often abused in many ways, is very necessary to a liberal government. That which is new and easy is what the world wants. It is always welcome, and those who possess the faculty, largely, of originating such ways are called "brainy men." A matter of so much importance should be given every consideration, and, in so doing, benefit ourselves and neighbors as well, always remembering that he who substitutes a new and easy way of doing work for the old and hard way, is just as much a public benefactor as he who made "two blades of grass grow where one grew before."

It is not necessary that one should originate some wonderful system for the accomplishment of great things, but rather the improvement in doing the small, every-day problems of life. If we but lift one pound from our own shoulders, or that of our neighbors' burdens, its significance, when multiplied by years, is of incalculable benefit.

Just here let me say that, ever and anon the sentiment is voiced by some one that new and easy ways of doing work are not for the best interests of the skilled workmen, for the reason that with improved appliances an unskilled operative will turn out more work than a skilled man can on the old machine. I have always thought this was the poorest kind of an argument. To illustrate, what reader of the SCIENTIFIC MACHINIST would undertake to turn a 3" shaft, 20 feet long, in an old, hand tool lathe, with nothing but a hook anchored to the floor to keep the shaft from jumping, in preference to a slide-lathe with follow rest? My experience among machinists is that they all want to run the best tool in the shop. Yet it is the growth of new and easy methods that sent the old hand-lathe, with its jaw-breaking tools, to the scrap pile.

If rails had to be forged by a smith and his helper, the demand for men in this branch of industry might be phenomenally large, but who could afford to travel over such costly roads? A machinist who was then in search of a job would be a tramp in every sense of the word.

Whether or not improved machinery is a benefit is a serious question and worthy of study. I am one of those who think that there is nothing too good for a machinist, especially anything that will advance him as a good citizen, anything that will add to his happiness or increase his comforts. Surely, new and easy ways of doing his work will continue to advance his interest, nor work to the injury of any one. Without further preliminaries I will contribute my mite.

Those machinists who run lathes in jobbing shops, that are without boring mills, have found trouble in holding a boring tool from turning in the tool-post while boring a deep hole, especially if a heavy cut is to be taken. I have seen lathemen, when doing this kind of work, drop old tools or pieces of iron in the slot of the tool-jack behind the tool at one end and in front of it at the other end of the slot, then fill in the space between the tool and the "stakes" with anything they could find that would fit. This way of holding the tool does first rate till the tool begins to chatter and spring, which loosens up the scrap and it goes jingling down over the lathe to the chips below, ready to be picked up and tried over again. I have had this experience myself, and have seen others who had even worse luck with this kind of a makeshift, neither have I ever been so fortunate as to have ever seen but one lathe that was built to hold a boring tool, and it was so clumsy as to condemn it.

In visiting a shop not long ago I saw a very clever little device that was simple, effective and, for anything I know, is free for any one to make and use. I will guarantee that it will hold a tool where it is put and not get lost while in use. The arrangement consists of two pieces of iron, or would, of course, be better if made of steel, that lie crosswise of the tool-jack with a projection on the bottom that fits in the slot. They are made of such thickness as will bring the top of the tool to the center of the hole, when the tool is in place on top of them. These pieces are bent up at one end and the bent end drilled and tapped at such height that a set-screw will strike the tool on its side about half way up. It will be seen that when the tool is screwed down on these pieces with the tool-post set-screw, and the set-screws in the piece set up against the side of the tool—both in front and back—that the tool can only move with the carriage. It may spring from the cut, but it can not permanently move. They will be especially useful in threading nuts in the lathe, when the tool can not only be firmly held but accurately adjusted. They are easily made and will well repay anyone for the trouble and expense of making, even if they only use them in lathes for boring occasionally. It will not be necessary to remove the ring on the tool-post, if the pieces are made a trifle thicker so that the tool will not rest on the ring. This device is to be used only for boring, and could not be readily made to hold the tool for turning, beside there is but little call for anything better than that in common use to hold a tool for turning. M. C. MAC.

THE USE OF MILLING MACHINES.

The construction of the machine having been carefully examined, and the novice having made himself familiar with the various classes of cutters, it is well if he is using a Universal machine, to choose some work at the outset that does not require the use of the spiral head. Such work is generally held in the vise when milled. The vise can be set with its jaws parallel to the spindle by placing one of the milling arbors in the spindle and then bringing the jaws up to the arbor. It can be set at right angles with the spindle by a square placed against the arbor and the jaws. The front of the table of the machine can also be used in setting the vise. The vise can be set at any angle with the spindle in the universal milling machines, by first setting the saddle at the given angle, then setting the vise parallel to the spindle, and lastly, bringing the saddle back to o.

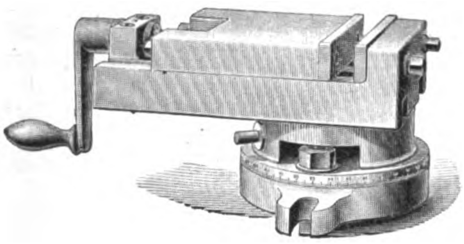


FIG. 1.

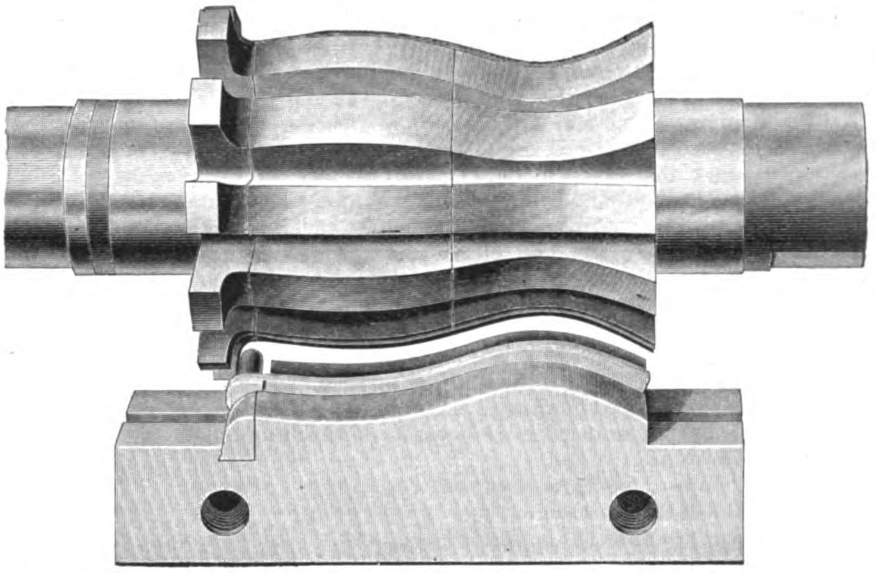


FIG. 3.

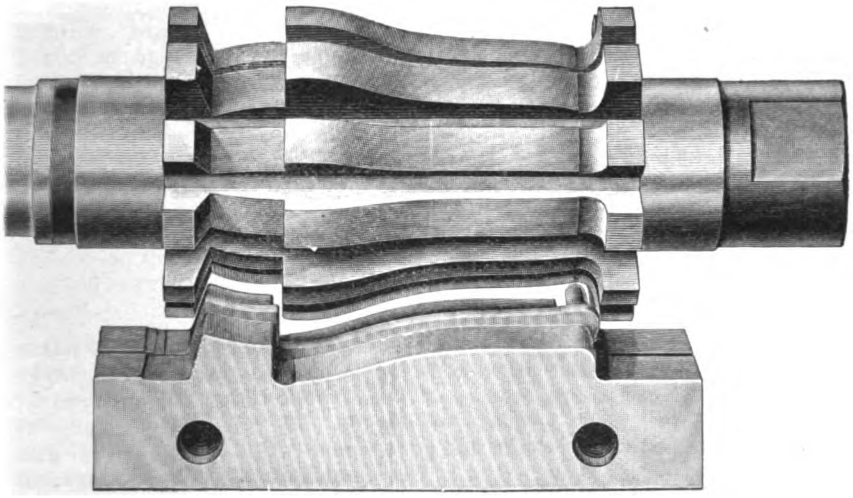


FIG. 2.

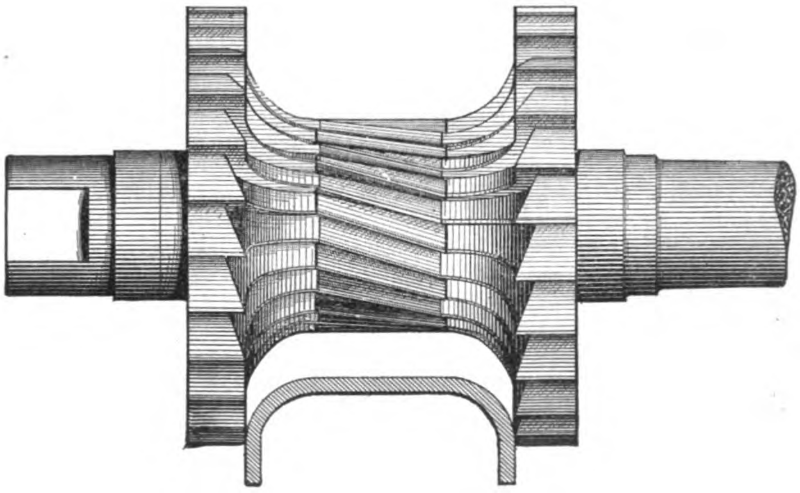


FIG. 4.

The swivel vise, Fig. 1, is especially convenient for angular milling. The base is double, and the upper portion is graduated so that the vise may be set at any angle with the ways of the machine. Small stock may be conveniently and advantageously cut into short lengths, especially when it is of a section not easily handled in a cutting-off machine. The table may be fed by hand or automatically, the stop being used to determine the length of feed, and the work may be placed exactly in the required position by noting the readings on the graduations around the end of the cross feed shaft. When cut in a milling machine the pieces are square at both ends and uniform in length. If it is desirable only to square the ends of small pieces and make them uniform in length, it may be done by first squaring one end of all the pieces, and then by bringing the finished end against a piece clamped to the immovable vise jaw to serve as a stop, while the other end is brought against the mill by the cross feed and run past it automatically or by hand, the vise jaws being parallel with the spindle. Combinations or gangs of form cutters are shown in Figs. 2 and 3. These figures represent the milling of opposite sides of small steel rods, 3 inches long and ½ inch wide. The vise jaws as shown are made to fit the piece. This is a class of work which is usually done on the small plain milling machines, and on which one boy can run several machines. A similar class of work, made by a combination of two form and one ordinary milling cutter, as shown by Fig. 4. This is taken from "A Treatise on the Construction and use of Milling Machines," by Brown & Sharpe Manufacturing Co., Providence, R. I. The book is an octavo, 182 pages and 100 splendid engravings. It is a work that every machinist should possess. The price is $1.00 in paper cover and $1.50 in cloth binding. Any reader who will cut this out and send it to the Brown & Sharpe Manufacturing Co., Providence, R. I., before February 1st, 1892, with 20 cents in stamps will receive a copy in paper cover, or with 50 cents, they will receive a copy in cloth binding.

Improvement in Turbine Wheels.

An improvement in turbine wheels consists in the application of a rubber cushion to its buckets, in such a form as prevents the dispersion of the jet into spray, which occurs to a greater or less extent upon striking a metallic surface. The motors are contained in a spherical case with flattened sides, and the inlet pipe is forked to deliver near the center on both sides of the motor. This delivery is into two chambers, or reservoirs, on either side of the central arms carrying the bucket rings and imparting motion to the shaft. Each reservoir is provided with four jet heads, and each head with three jet holes one-sixteenth inch in diameter, lined with bronze, making 24 delivery jets in each motor; these streams, delivered at an angle of 45 degrees, strike upon the buckets contained in a cold rolled copper bucket ring, and each ring contains 120 buckets. The reservoirs are bolted to the frame, with lead gaskets between, and by the construction of the bucket rings an excess of weight and all liability to rust are avoided. As compared with ordinary wheels, those with the rubber covering show a difference of 30 per cent. superiority. The rubber as thus applied of course does not cover all the bucket, as the discharge lip is left free.

Where Fine Whetstones Come From.

The interesting claim is made for Arkansas of furnishing the finest whetstones of any to be found in the United States for the sharpening of fine-edged tools, there being in that State remarkable beds of the substance called novacalite, or what is scientifically known as an altered schist; this means a deposit of a flinty nature, usually combined with limestone, the rock thus produced being changed in such a manner molecularly, by processes not altogether understood, as to supply a surface peculiarly suitable for grinding. The entire supply of novacalite for the United States is furnished by Arkansas, also filling a large part of the export demand. The main deposit of this remarkable material is in a single hill about five hundred feet high. It is a very beautiful stone, of snowy whiteness, and is quite costly, because, owing to its extreme hardnesss, it has to be cut by diamond dust. For the sharpening of keen-edged tools, razors excepted, this novacalite is regarded as unrivaled.

Practical Letters.

Soldering.

EDITOR SCIENTIFIC MACHINIST:

As you solicit correspondence from practical mechanics, to publish as a means of education, I will contribute a short article, and if you consider it worth publishing you are at liberty to do so. I am convinced that diffusing knowledge in the way that you propose will do the most good to the readers of your valuable paper, in the shortest possible time. I am sure, also, that it meets with disfavor from a certain class of mechanics, generally from the older ones, who have spent their life-time in acquiring those tricks of the trade (so to speak) that make their services so valuable to their employers, and who think it a detriment to the trade to educate other than by actual practice.

"Let them find out by working and studying as I have done," is a common expression with them.

The only reason I can see for concealing useful mechanical knowledge among workingmen is purely a selfish one. "If I teach a man to do what I can do, then he is able to take my place," is the argument. Even so. But are we not all builders upon others' thoughts and works, to a great extent, for what we know and can do? And are we not still so dependent that we can learn something new *to us* every day from others? In my experience I have often found a word of advice to equal years of patient work and study, and feel grateful for it. Consequently, I do not have any scruples about giving any instruction that may benefit my co-workers in accordance with the above.

I will direct a few remarks to young machinists upon the art of soldering.

I claim no new principle, but some of the different methods of using to advantage. I also do not propose to go into details of the many different varieties of work that can be done, but to give a few examples that will furnish food for thought and action on the part of the mechanic himself.

All machinists ought to know how to solder and do it right, but comparatively few do. In the first place, the machinist's iron should be a heavy one in most all cases (for reasons that will be explained in the course of this article). In the second place, "acid" properly prepared. Then, with a heater, or forge, good solder (half and half is most generally used), you are ready for work. Most every machinist knows how to solder pieces together over a flame, so I will say nothing on that point. Get the iron ready by filing the squared point with an old file, until the copper is bright. Heat it hot enough to melt the solder, dip the squared point in the acid, then rub on the solder till well tinned.

Never attempt to solder without the iron being hot enough. It will work all right if heated to a slight tinge of red, if dipped in the acid.

We now proceed to

EXAMPLE NO. 1.

We wish to solder together on their edges, two pieces of sheet brass, 4"x12"x⅛", so as to form a right angle. Place one piece flat upon an even surface horizontally. Hold the other against it perpendicular with a tri-square with one hand, then tack it at one end, holding firmly until the solder sets. Move the square to the other end and do the same. Now you have it square and can handle it at pleasure. Place it in the shape of V. Commence about 2" from one end so as not to loosen the ends. Hold the stick of solder in one hand, the iron in the other, and draw it slowly, feeding the iron from time to time with enough solder to make a good joint. By the time you are at the opposite end, the solder has become firm almost the whole length, then you can finish off the ends. The utility of the heavy iron is here obvious, as it has to transfer its heat to the parts to be soldered, to make them hot enough for the solder to flow. A light one becomes cool too soon, and you cannot do good work. The idea to be conveyed is to get the pieces in the right position first, then not try to do it all at once, but tack it at the different points, so you can handle it without changing its position. Many difficult jobs can be done in this way.

EXAMPLE NO. 2.

In soldering two pieces of sheet metal together always bevel their edges to allow more surface for the solder and to give strength. Place the pieces flat upon an even surface, hold them in position by a weight, or a piece of iron in the hand. By this means you will have a strong, serviceable joint. Many difficult jobs can be done in the lathe, planer or shaper, by the use of a little solder that is almost impossible by ordinary means.

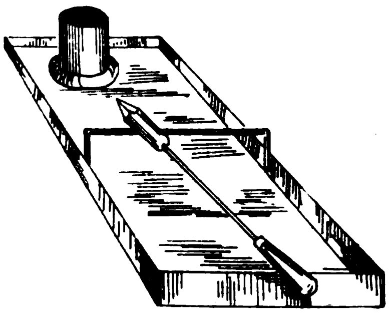
EXAMPLE NO. 3.

We have a number of irregular pieces to be planed parallel on both sides. The work cannot be caught in the chuck without a great deal of time and trouble. Or, if you did, it would spring so when you have it planed it would be out of shape. There are two ways of doing this work perfectly. First, for small work, by clamping a solid piece in the chuck, planing it off and soldering the irregular pieces on it. Second, for larger work on the bed of the planer for which I will give the plan in detail. First, clamp two strips of sheet brass across the bed of the planer far enough apart to equal the length of the piece to be planed. Second, put other strips of the same across at different places between them. These do not require to be clamped. Third, brighten the work to be planed by filing it at the ends and sides, or wherever you wish to apply solder. Fourth, place it upon the strips so that the end may come in contact with a plug in a hole in the planer bed. Fifth, get it as nearly parallel as possible, by means of wedges. If you have no iron ones, use wood. Sixth, apply some acid, then solder firmly at the ends, then at the sides in as many different places as necessary. The solder will run under a little and make a good bearing. Take the first cut and it will be true. Seventh, remove the strips, clean off the solder by means of the hot iron and sharp chisel, spread the end strips apart to allow the work to just go between them, place the work flat on the bed and solder the ends only, plane, and you have a perfect job. I do not think these examples need any diagrams to be understood.

DIRECTIONS FOR MAKING ACID.

Take muriatic acid of any desired quantity. Put it in an earthen jar, add zinc to it until it stops boiling or eating. It should be done in the open air or at any place where the fumes will escape readily. It is better to let it stand until thoroughly cut. To make the solder flow nicely add a small piece of sal-ammoniac to the acid.

A HANDY SOLDERING BOARD.



Take a board 18"x12", nail some strips on the edge to form a flange all around about an inch high. Bend a ⅜" iron rod to go across the center, 2" high and fasten at each side. This rod acts as a handle to carry it, also as a rest for the hot iron. Form a recess at one end for the acid cup, and it is now ready for use.

KINKS.

Attachment for Drawing Board.

EDITOR SCIENTIFIC MACHINIST:

I enclose herewith a rough sketch of an attachment for a drawing board, which I invented some years ago, and having never seen it in use elsewhere, I thought it might be of some benefit to some of your readers who, like myself, are what are known as a jack-of-all-trades. I think it can easily be illustrated, its cost is a mere trifle, and although I am not an experienced draftsman, yet I believe that those who have nothing better will find it well worth the trouble of making. It consists of a wire bent in the form shown in Fig. 2, the ends being formed to receive a round lead screw. I used a No. 8 iron wire for a board 18 inches wide, though steel might be better. Form the wire so that when it is on the board, as shown, the wire curves slightly toward the board, as shown by the figure. Fasten the wire with screws, at each end, and drive staples over the straight part at A A, being careful to have the wire true enough so the T-square will lie flat on the board without pressing on the wire. Now place the T-square on one edge of board and place a round lead screw just inside the wire, and screw into under side of square until the it draws slightly on the wire, when it is completed, and it will be found that the square can be slipped along from top to bottom of board very easily and the pressure of the wire holds it firmly in position. It can be taken off by raising the blade of square first, when the screw unhooks from the wire.

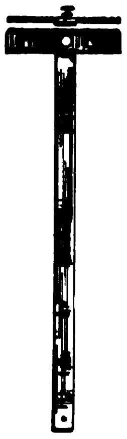


FIG. 1.

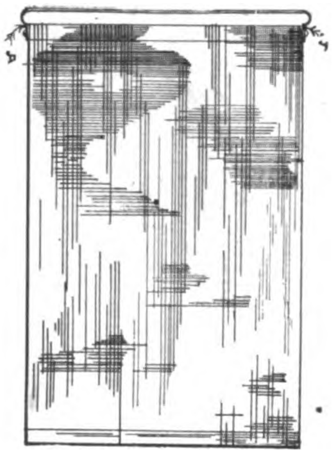


FIG. 2.

H. L. CHAPMAN.

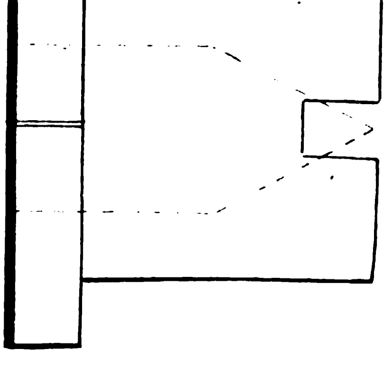
A CHAT WITH THE TOOL MAKER.

BY FRED H. COLVIN.

Although I have aimed my blunderbuss at the tool maker, it is liable to spread its charge until it strikes some of the others in the shop; however the charge will not be dangerous, but will I hope prove of benefit to all who receive it.

There are many little kinks that go to make life easier for us all and by giving them to others we help them along and usually get good ideas in return.

To any one who has flat cutters or other flat work to do (by this I mean pieces of flat steel or iron that require to be turned), the question of how to hold them is often a puzzling one. It may be put down as a general rule that *all* work should be centered and have the centers drilled and reamed to fit the lathe centers, preferably 60°, and this case is no exception. There is work which does not need centering and which it is a waste of time to center, but these cases are extremely rare, and need not be considered now. Having a flat steel cutter to turn up, the steel of 3x5x¼ inch, and it is not a handy thing to use the regular lathe dog or even a clamp to drive it with; so, after centering it in good shape, let us see how it can best be driven. Procure a piece of cast iron, the regular shape of the lathe "master chucks" and thread it to fit the spindle of your lathe. Leave the outside rough, for there is no need of finish, and besides it leaves it stronger to stand the strain of the work.



The cut will explain itself, although it does not show the thread in the chuck. The chuck is bored out to allow the lathe centers to pass through as shown by dotted lines until it projects about as shown in the cut. A slot across the face of the chuck, as near the center as possible is all that remains to be done and the carrier is completed. It will not be difficult to see how, by placing the piece of centered steel on the center, it will come within the slot across the face of the carrier and be driven very firmly and positively. The ease with which the piece to be turned may be removed for examination and replaced always in the same place will commend it to those who have much of this kind of work to do, and no one can object on account of cost, as that is trifling.

I have not shown the thread or any detail in the cut, except what was absolutely necessary for the showing of the idea, for I do not think a cut is as easily understood when it is encumbered with lines that do not bear directly on the subject. These extra lines are especially misleading to any one not accustomed to reading drawings, and as they are not necessary it seems best to omit them. As for drawing threads, *i. e.*, making all the detail of the threads, showing pitch, etc., it is worse than useless unless for practice By just making lines to represent threads and then marking the pitch and kind of thread is all that is required, so that it seems like a waste of time to go to the trouble of drawing them in detail. A great many of the large shops are following this plan now and find it a great saving of time.

This carrier is not new, but has been in use in one shop that I know of for over eight years with good satisfaction. Though not being new I have never seen it in use elsewhere, and, as it is such a handy tool, think it will find a wider application by making it known through the columns of the Scientific Machinist.

Its use is not confined to the pure and simple flat cutters, but to modifications of them, as we often see in shops that use small turrets. They will use a flat cutter having a round shank. These can be held in the same way for turning the shank, then held with the ordinary dog for the other end. In turning flat reamers, taper reamers at that, it is especially useful, and this is the work that led to its trial and adoption. In taper work, especially when the steel is flat, it is a nice job to get it held firmly, yet move on the live center, as all taper work has to, on the ordinary lathe (lathes where the head does not swivel), but this will do the work in good shape.

The only precaution necessary is to have the slot of sufficient depth to allow of the cutter swinging its full travel when turning from one position to the other. Those who are familiar with taper work will understand the meaning readily. Those who are not will receive much benefit and help in understanding it if they will try setting the lathe "over" and then watching the work as it revolves. If you are handy at drawing, you can diagram it out on paper and show the positions it assumes. It will give you practice in drawing and studying them and will show you just how it works. If any one will express the wish, I shall be glad to show the action of turning tapers in a future paper, but if no one does so, shall assume that all the readers understand the action.

A little experience that a friend of mine once had may be of use to some of the readers of this paper. He was a tool maker, and a good one, but the result of his work did not please him this time. He got a piece of steel from the blacksmith, and turned up a nice reamer, made a good job of it, milled it and filed the cutting edges. Then he took it to the fire and hardened it, tried it with a file and found that it was soft. This was not pleasing to him, and he tried again, thinking that he might have been deceived as to the heat before cooling, but it was no better than before. Then he knew it was a piece of machine steel and not tool steel, as it should have been. The mistake occurred from the steel being mixed by the blacksmith's helper, when putting it away, for hardly any one can tell by the look of the piece of steel whether it is tool or machine.

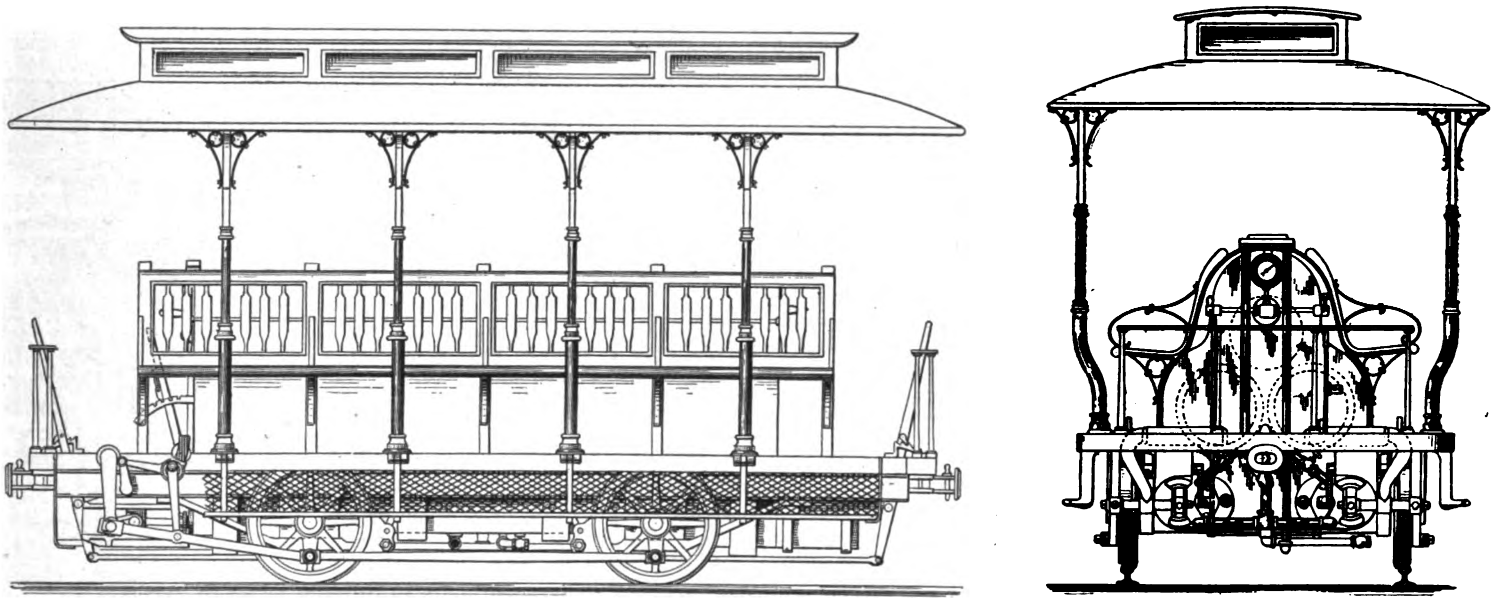
In some shops they mark all steel as it comes into the shop, and mark is so it can always be seen. As pieces are cut off the bar, the ends that are cut are marked, leaving a mark always on the bar itself.

It is easy to make stencils if you have not got them already, for all you need for this work are the letters T M and I, for "tool," "machine steel" and "iron," though the iron can nearly always be told by looking at the end of the bar. Still it is better to be sure, and the letters don't cost much either to make or buy. The time and patience that these will save make them almost a crying necessity.

THE STANDARD FIRELESS ENGINE.

The Standard fireless engine, which obtains its power from the vaporization of ammonia instead of from that of water, is claimed to be a pronounced success. An exhibit of it is being prepared for the World's Fair and preliminary tests are being made with the first motor on the Exposition grounds at Jackson Park. It effects a marvelous economy. Raising ice to the gaseous state or steam requires the application of considerable heat, yet it is easily possible to get other substances which pass into liquid and gas at much lower temperatures. Ammonia becomes gaseous at 38½ degrees below zero or 250½ degrees of temperature less than water requires to effect the same change.

The ordinary atmosphere is fuel sufficient and ammonia is par excellence the substance for evolving power owing to its affinity for water. The fuel consumed in the running of street cars by the Standard fireless engine costs under favorable circumstances only a fraction of a cent a mile for each car. The aqua ammonia of commerce consists of 70 per cent. of water, and 30 per cent. of ammonia. In the process the ammonia is separated from this solution at a stationary plant by the application of heat in a manner similar to that used in ice works where the absorption principle is employed.



THE STANDARD FIRELESS ENGINE.

The apparatus on the car to be charged consists of two parts, one within the other. The inner vessel receives the charge of the liquid anhydrous ammonia, which has been separated from this solution, and the outer vessel is charged with a portion of the weak solution blown off from the bottom of the still or retort. When thus charged it is ready for operation. The temperature at which the solution is charged is 80° Fahrenheit, and this gives a pressure of about 150 pounds per square inch on the inner vessel. The pressure pipe to the engine from this inner vessel has a throttle valve as in ordinary steam engines. By opening this throttle it works the engine in a manner similar to steam. The exhaust is into the water in the outer tank and is instantly absorbed, so that, when the charge is run off, the outer tank contains the aqua ammonia, the same as was used in the first place at the stationary plant. This is withdrawn at the stationary plant and returned to the steel to be again separated and a fresh charge put in. There is no fire in the cars and no escape in the atmosphere. The material is used over and over. The cost of this system is that of the fuel consumed at the stationary plant for separating the materials and that of the necessary attendants. Cars can be made to run any distance from five to 50 miles on one charge, and as a car is charged in two minutes there is no appreciable loss of time. Instances of the success of the engine in running street cars might be quoted in detail. Mr. P. J. McMahon is the inventor. A company has been organized to take hold of this process and manufacture. Their offices are at 433 Manhattan building, Chicago.

Holiday rates on the Nickel Plate, December 23d to January 1st, inclusive. Returning to January 5th, 1892. One fare for the round trip.

To the Reader: If not a subscriber you should subscribe for this paper. It contains more matter of merit for the price than any other mechanical journal. See our REMARKABLE offer on page 8, which holds good only a short time. Don't fail to take advantage of the best bargain you will ever strike.

For preserving wire ropes, carried under water or under the earth's surface, a mixture of 35 parts of slaked lime and from 50 to 60 parts of tar is recommended. The compound is boiled and applied to the article hot. For dry-lying cables a thick mixture of graphite boiled in tallow, and one of crude linseed oil and vegetable tar have both been tried with success.

The London Board of Trade returns show an increase of imports for November of $33,550,000 and a decrease in exports of $11,150,000 as compared with the same month last year, said to be largely due to the American tariff.

For a good solution for removing blue from steel, so as to leave as clean as before coloring, try acetic acid or solution of chloride of tin (stannus chloride).

The Nickel Plate makes one fare for the round trip, December 23d to January 1st, inclusive, account Holidays. Returning limit to January 5th, 1892.

RULES FOR MACHINERY HALL AT THE WORLD'S FAIR.

Rules for the guidance and government of intending exhibitors in the Department of Machinery have been issued by Chief Robinson. The regulations, which are official and approved by Director-General Davis, are as follows:

Rule 1. Exhibitors must be manufacturers or producers of machinery and not dealers only.

Rule 2. Exhibitors, or such agents as may be designated, shall be responsible for the receiving, unpacking and arrangement of objects, as well as for their removal after the Exposition.

Rule 3. No person can exhibit in another one's place without express permission of the head of the department.

Rule 4. No exhibitor will be permitted to erect or arrange his exhibit to obstruct the light, or occasion inconvenience, or disadvantageously affect the display of other exhibitors.

Rule 5. No machinery on exhibition will be allowed to run longer than is necessary for that purpose, except by special permission of the chief of the department.

Rule 6. Steam pressure applied will be 150 pounds per square inch above the atmosphere. Exhibitors requiring a lower pressure can obtain it by using a reducing valve.

Rule 7. The line shafting will be placed 16 feet from the center of shaft to floor of building, unless otherwise decided, in which case due notice will be given. Size and relative position of shafting to space alloted will be shown on permit.

Rule 8. The line of shafting will make 120 and 240 revolutions per minute.

Rule 9. Driving pulleys on main line of shafting must be in halves and limited to 36 inches diameter. They must be secured in a manner that will not weaken the shaft, and be subject to the approval of the chief of the department.

Rule 10. The main lines of steam, water and sewer pipes will be laid by the Construction Department, but all connecting pipes, valves, etc., will be supplied by the exhibitor.

Rule 11. No steam or water pipes will be allowed to cross over passageways, except as especially provided for in Group 68, Class 403.

Rule 12. The water pressure will be that due to a head of 200 feet, or a pressure of about eighty-six pounds per square inch.

Rule 13. The chief of department will have care and supervision of the main shaft, but all gear supplied by exhibitors will be under their care. They will also select persons to attend to their machinery, who alone will be allowed to operate it.

Rule 14. Exhibitors of steam engines, boilers, steam pumps, machine tools, shafting, separators, feed water heaters, steam traps, etc., who desire to offer their exhibits or a portion thereof, for use in the department, should send in their application for space, or otherwise notify the head of the department as soon as possible.

Rule 15. Exhibitors furnishing machinery, such as engines, boilers, etc., for use of the department, may select their own men to operate them; their wages will be fixed and paid by the Exposition company.

Rule 16. The Exposition company will defray the necessary expenses of exhibitors loaning their machine tools for use, beyond that which they would have incurred as exhibitors simply, wear and tear excepted.

Rule 17. Fire engines entered for exhibition, offered and accepted for use, will be properly cared for and furnished with fuel free of expense.

Rule 18. All platforms, counters, ornamental partitions, showcases, and appurtenances of above design, must be erected at the expense of the exhibitor, and shall not exceed the following dimensions without special permission of the chief of department: Showcases, fifteen feet above the floor; counters, two feet ten inches above the floor, next to passageway; platforms, one foot above the floor; partitions of various heights, not exceeding fifteen feet, of approved design, may be erected in certain parts of the building.

Rule 19. All exhibitors of machinery in motion must be inclosed by a railing of uniform height of two feet six inches, the railing to come within the space. All designs of railing, showcases and signs must be submitted to the chief of department for approval. No signs will allowed to extend over passageway, nor will signs of muslin, linen, canvas, or paper be permitted.

Rule 20. No fires will be allowed in Machinery Hall except by special permission of chief of department. Not more than a day's supply of oils and other inflammable material will be permitted in the building, but a suitable place will be provided for the storage of the same.

Rule 21. In every case applicants for space are requested to give timely notice if they decide not to exhibit.

Rule 22. Permits will be issued by the chief of department to bring in raw material required for the successful operation of certain exhibits, and such articles as may be required by concessions and privileges before 15 minutes of the opening of the Exhibition in the morning. Also for the removal of such articles and products as come within the regulations.

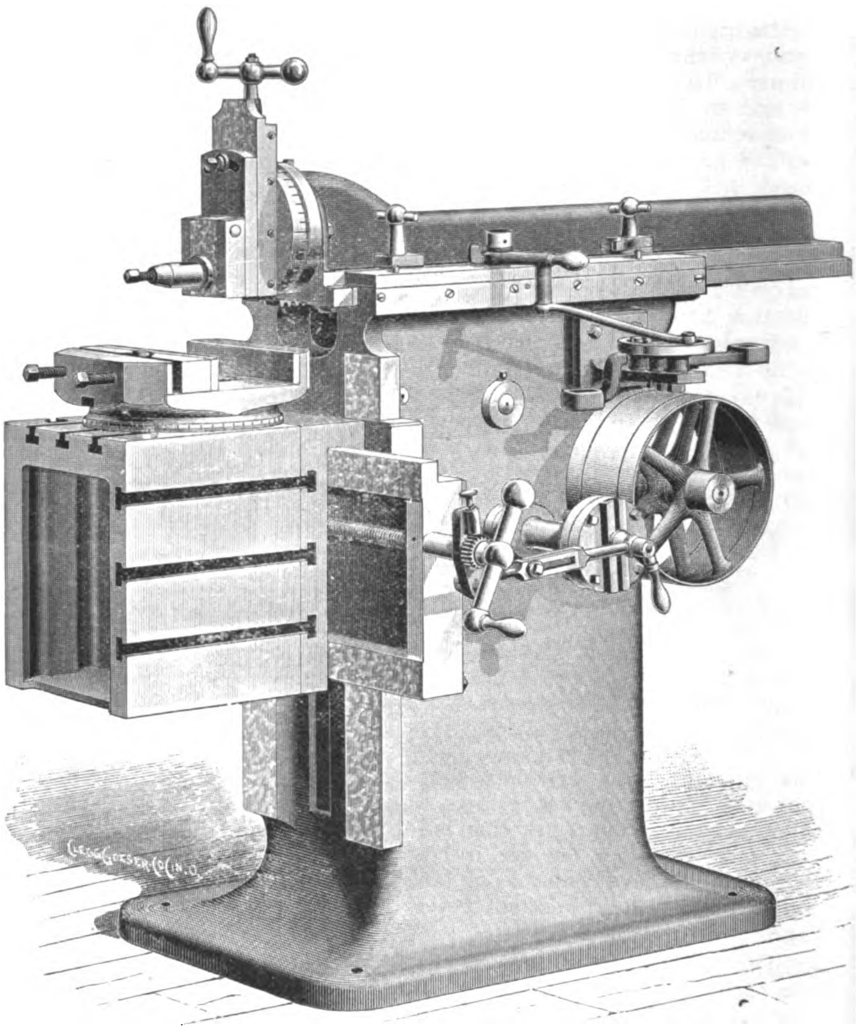
Rule 23. The location of exhibits in Machinery Hall will be indicated by rows of columns and the number of the nearest column in the row. The rows will be lettered A, B, C, D, etc., from the south side, and the columns numbered 1, 2, 3, etc., from the east end. Example: "Exhibit No.—B, 71."

Looseness of Structure in Steel Rails.

Herr H. Wedding, in a paper recently read before the German Society of Railway Engineers, said that comparative examinations of rails of various profiles showed that looseness of structure (*Lockerkeit des Gefuges*) on the upper surface increased in proportion to the size of the head. Looseness of structure in the interior forms, however, only in rails having a very large head, and so increases that in the case of Goliath rails a loose cylinder is constituted. The upper surface of the rails, on the other hand, is always less solid than the underlying portion both in large and in small rails. As the looseness of structure in the head of the rails now in use is no drawback, for they last the stipulated period of 12 years ere they become useless by reason of wear, it must be assumed that the inconsiderable greater looseness of the head of Goliath rails does not bring with it any disadvantage. This view is confirmed both by microscopical investigation and by the durable qualities manifested. It would appear as if a pressure exercised on the head of the rail while it is being rolled decreases in a corresponding degree the looseness of the upper surface.

26-INCH TRIPLE GEARED SHAPER.

The accompanying cut represents an improved 26-inch triple geared shaper. In designing this machine great care and attention has been given to those requirements and principles so essential to the perfect working of a machine of this class. It is strong and substantial throughout, especially in parts affected by the strain of the cutting tool. The sliding surfaces, unusually long and heavy, are provided with accurate adjustment, and are well fitted by hand scraping. Driving pinion and intermediate gear are on the outside of the machine, permitting the use of an extra large gear, increased speed of pulleys and subsequent gain of power. Driving pinion makes 42 revolutions to one of rack wheel, giving a high belt velocity, allowing the belts to move easily and quickly. The double gearing consists of two steel racks, two rack wheels and one double pinion. The racks instead of having the teeth placed opposite each other are so set that the tooth on one side is opposite the space of the other. This gives a steady, even stroke, equalizing the strain of cut by applying the power direct on each side of the tool. It also obviates any lost motion. The belts are shifted by a circular plate having eccentrical slots which receive the studs on the shifter arms. These slots are constructed in such a manner so as to move one belt before the other. By this arrangement the shifters are always locked so that the belts can not move them in case there is a tendency to travel. The machine runs silently and reverses without jar or shock. Stroke can be changed instantly while machine is in motion or at rest. Screw and gears for raising and lowering the cross rail are on the inside of machine and protected from dirt and chips. The opening under the ram admits long lengths of iron being passed clear through; this adapts it for cutting key-ways in shafting of any length and up to 3¼ inches in diameter. The tool box can be detached and a tool inserted in the end of ram for cutting key-seats in pulleys, gears, etc., the feed being obtained by moving the table upward. The box table furnished with each machine is slotted on top and both sides, and can readily be removed and work bolted to the slotted apron, to which the table is attached. Graduated swivel vise or chuck and all necessary wrenches furnished with each machine. Length of stroke, 26 inches. Automatic cross traverse, 26 inches. Vertical adjustment, 20 inches. Feed of tool block, 9 inches. Top of table, 14 by 18 inches. Countershaft is arranged for two speeds, and should make 200 revolutions for steel and 275 revolutions for cast iron. Weight 2,000 pounds. For price and further particulars address John Steptoe & Co., West Second street corner Central avenue, Cincinnati, O. It will be to your advantage to write them at once.



In one week recently the Girard Furnace of the Girard Iron Co., at Girard, O., turned out 1,324 gross tons of iron. This furnace is now in the fifth year of the present blast, and during that time there have been no repairs of any consequence made to the stack.

LIQUID STEEL ROLLING AN AMERICAN IDEA.

In a recent paper on the evolution of the American rolling mill, Mr. R. W Hunt greatly raps the knuckles of Sir Henry Bessemer as follows: I will close with a reference to the latest radical departure, which, while not yet quite a commercial success, still has been placed in a sufficiently prominent position to deserve record. I refer to the rolling of liquid steel by Mr. Edwin Norton, at the works of Norton Brothers, in Chicago. It has been know for some time that Mr. Norton was experimenting in this direction, and, in fact, had taken out patents in this and other countries. The paper read by Sir Henry Bessemer at the late meeting of the Iron and Steel Institute on "Rolling Fluid Metal," and which has already been published in several of our technical papers, has called renewed attention to this system of producing sheets for tinning.

The commercial changes in the tinplate industry have been somewhat violent of late, and appearances indicate that the location of a large part of the manufacture may come to this country. At all events, changes which will cheapen the production have become necessary, no matter where the plates are made.

The Messrs. Norton are the largest individual tinplate consumers in America, and as such have naturally kept fully in touch with all phases of the trade. Mr. Edwin Norton is the mechanical member of the firm. Some years ago he fully perfected the rolling of soft metals direct from the liquid state into finished sizes. He was fully posted as to what had been attempted in the years past in such rolling. His success with soft metal led him to go further and strive to do the same thing with liquid steel. He had encouraging results. He protected himself by patents at home and abroad. He felt full reverence for all that Bessemer had given the world, and knew that some thirty odd years ago he had experimented with this very process, and thought he knew wherein Bessemer had not gone quite far enough to insure complete and uniform success. Still he felt that he deserved recognition. Moreover, Mr. Norton as a successful American, duly appreciated the advantages which would naturally accrue from having Bessemer indorse and become interested in his process. For these reasons, after protecting himself by patents, he wrote Sir Henry Bessemer, also sending him a piece of sheet which he had rolled credit from liquid metal, explained what improvements he had made, and proposed an honorable commercial relationship. Certainly there was nothing disrespectful in this, no matter how great the man to whom it was made.

Now mind you, up to this time Bessemer seems to have attached little importance to his experiments of many years ago. Messrs. McKinley and Norton recalled them to his mind and gave them value. Perhaps this is none of my business, but Sir Henry has aroused my American ire. He says:

"I received, about two years ago, a parcel from America containing a small sample of sheet metal, which was being successfully manufactured there. The person from whom I received it informed me that it was made by a slight alteration or improvement on my patent of 1857, for rolling continuous sheets and thin bars of iron or steel direct from fluid metal. He offered me one-half of his patent if I would undertake its introduction into this country. I did not accept his offer, and there the matter rested.

"The circumstance stated has, however, afforded me an opportunity of showing you a small sample of a continuous sheet, produced direct from fluid metal at a single operation, and proves beyond doubt or question the important fact that fluid metal may be chilled and formed into a continuous sheet between rolls that are kept cold, while it well illustrates the spirit of enterprise of our American cousins, who are so prompt to recognize, to adopt, and to improve upon the inventions brought forward in Europe."

I think he might have treated Mr. Norton a little less cavalierly without any prejudice to his great fame. This thing had lain dead all these years. Should not some honor be given to the man who was able to put life into the corpse, and conquer for it a place among live industries? The greatest have always been under obligations to others for portions of their triumphs, and always will be.

The Bessemer process was a failure for all but the higher purposes until Mushet's invention; and while Sir Henry honored himself by settling an annuity upon Mushet, who at that time had made nothing from his invention, still I for one would have had my already profound respect increased if Bessemer had even mentioned Mushet's name in his letter giving the history of his process, which was read at the Pittsburg, Pa., meeting of the Iron and Steel Institutes.

We honor you, Sir Henry, and are proud to have your portrait hanging upon the walls of our society house, and hanging in company with that beloved departed member who did so much to create our organization and so much to add to your great fame, but I am not willing that you should have all the credit for the last development in American rolling mills.

1892.—MECHANICAL SCIENCE FOR ALL.—1893.

Below is given an outline of the contents of the "Scientific Machinist" for 1892. These papers are not merely contemplated, but will positively be published. We can mention only about one-half of what is coming at this date. Most of these will begin at once and all soon. Nearly all will be finely illustrated. Any subscriber can have any subject within our scope treated by simply making the request. Our staff of special writers will give what is wanted.

Steam-Engine Building and Repairing. These will be by able men and will cover the ground thoroughly.

Steam-Boilers. This series comes from a writer recognized as authority throughout the country. No one should miss his papers.

Steam-Pumps. These are being prepared by one engaged in building all kinds of pumps. Their use and how to keep them in condition will be made plain in a practical way.

Erecting Steam Plants. A well known and popular author will, in this series, give valuable instructions for setting up plants of all kinds.

Shop Practice, Kinks and Methods. Several different writers will furnish papers in this line. There are too many to mention specifically in this brief outline.

New and Easy Ways of Doing Work. This has reference to the Machine Shop, and more than one will contribute to it.

Pattern-Making. The papers under this head will be found very useful to every pattern maker.

The Anvil and Forge. A practical blacksmith will write on his craft under this head.

Foundry Work. We are only able to say about these that they will be first class.

Practical Electricity. The "Electrical Lessons," now in the ninth number, will be continued under this head, and when finished will be published in pamphlet form. Every yearly subscriber beginning after this date will get a copy free. A special writer will, outside of the lessons, treat every phase of electrical practice as applied in engine room and shop.

Questions and Answers, Practical Letters, New Tools and Devices, Scientific-Mechanical Special Articles, Miscellaneous Notes and Papers and illustrations of the finest quality will be found in every issue. We can not begin to give every detail of what is coming. Are you paying money for mechanical information? if so, do not leave us out. Please note our ExtraInducement on page 3. Kindly show this to your friends and associates, and get them to subscribe.

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"Drumming" the World's Fair in Europe.

We must confess that as a nation we are miles behind our American friends in their modes of pushing and advertising their goods, and whilst we cannot but admire their energy and cuteness in extending their trade connections, there are certain limits beyond which we have, as yet, not cared to go. It may be that we are a little thin skinned in these matters. We cannot pretend that as a nation we are less anxious than they to increase our trade, seeing that our prosperity depends upon our commerce. Having admitted thus much, we still find ourselves, to put it mildly, greatly astonished to see the great lengths to which touting is carried by Americans. The strangest part of the matter is that the preceding remarks do not refer to firms or individuals, but to the Government authorities. The extraordinary efforts, official and otherwise, that are being made to ensure the success of the Chicago exhibition illustrate our meaning. We find deputies of senators and high officials sent round the various capitals of Europe, supported by every introduction and recommendation which the highest State authorities can give from one nation to another. This, of course, leads to pressing "recommendations" from the Government thus appealed to, to the various industries under its influence, deputation to Chambers of Commerce, Boards of Trade, etc., and it is very well known that there are many large firms, to whom a recommendation from such a source amounts to a command. If this is so in Germany, what effect must such official touting have in countries where the governing authorities are not dependent upon the votes of the populace. The inconsistent part of the affair is that this pressure is brought to bear by the one nation which professes to be able to do without the aid of others, which puts prohibitive duties on all goods supplied by other countries, and even goes the length of passing laws to exclude continental workmen settling down among them. We believe that the Chicago Exhibition will be one of the finest ever held, and we do not doubt it will be a great success, but surely it would be more dignified to attain this end through the customary commercial channels, than by the means now taken. This example set us by our American friends, is one that we devoutly hope no other nation will follow.—[Kublow's German Trade Review Berlin.

Steam and Magnets.

The influence of steam on magnets is the subject of an interesting note in the *Schweizerische Bauzeitung*, in which reference is made to the researches of Strouhal and Barus. These have shown that with long continued heating in steam, magnets lose from 28 to 67 per cent. of their power. If, after this, the magnets are remagnetized and again exposed to the action of steam, only a very slight loss of magnetic power is found to take place. The experiments which have been made would seem to warrant the conclusion also that after such treatment a magnet is less liable to deterioration from mechanical vibration as well as heat. In one of the experiments, a short magnet was boiled in water for four hours. It was then magnetized and held in an atmosphere of steam for two hours more, after which its magnetic moment was measured. It was then subjected to 50 blows from a piece of wood, both transverely and longitudinally. Again measuring its magnetic moment, showed a loss of $\frac{1}{900}$, and in repeating the hammering with the wooden bar the loss was $\frac{1}{400}$ of the original moment. In view of all this, repeated steaming and magnetizing is recommended as a good means of securing permanent magnetism in pieces of hard steel.

Krupp's Great Rolling Mill.

The rolling mill which has recently been built at the Krupp Works, at Essen, Germany, probably surpasses in size and effectiveness any similar plant in the world. It is used for rolling armor plates, and is able to turn out finished plates 28 inches in thickness and nearly 12 feet wide. An idea of the size of this ponderous piece of machinery may be obtained from the statement that the rolls, which are made of crucible steel, weighed in the rough state 100,000 pounds. The entire plant of rolls, reversing engines and heating furnaces, is served by cranes capable of moving 300,000 pounds, while the shears, with long, steel blades, cut through the plates as easily as ordinary shears cut through paper. The entire work, from the ingot to the finished plate, is handled by hydraulic automatic machinery.—[Manufacturer's Gazette

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IT costs $25,000 to secure a patent in all the countries where patent laws exist. In Cape Colony, at the extreme southern part of Africa, the cost of a patent is $925, and we are told that only two patents have ever been issued, one being the Bell telephone, and the other unknown to our informant.—[Manufacturers' Gazette.

A WOMAN MACHINIST.

"Customers don't pay, but creditors won't be put off. Business is duller'n a Summer resort in December. Hain't no chance for a man unless he's got plenty of money, blamed if ther' is."

This pessimistic declaration came from a loutish young man in a grimy pepper-and-salt suit, as he ground about a quarter of a pound of the weed between the millstones of his molars and ejected the molasses colored fluid through an open door about a rod distant.

"All the more reason for bein' cautious," answered a little, old man, with a hard, cunning face, who sat at an old-fashioned desk and fondled a silver dollar in a manner that left no doubt what god claimed him as a devotee. "Can't be too careful under sich sarcumstances," he said. "The note of $800 is due day after to-morrow, a Friday, and instead of liftin' of it you want to borry more. I say I can't give it 'thout you secure it with a mortgage. No man with good intentions would squeal at that."

Columbus Blount, who made the opening remarks, gazed out of the window and down the street at the little machine and blacksmith shop which presided over him. It was a low, square building with a gable roof, standing in the rear of a yard filled with the mortal remains of old wagons, farm implements, stoves, grindstones and nondescript rubbish. When the wind lulled he could hear the "chang, chang, chang," of the hammer in the smithy and he occasionally noted a horse led away, his feet re-shod for the renewal of the pull of life.

"Well, Pinch, you know that my sister M'tilda has a half interest in the shop," said Blount. "I'll see her and ask her to sign. Don't know as she will, but I think I can work her around to it."

"All right, all right," said Peter Pinch, in a sharp, business like manner. "That will then be to back a note of $1 500 for six months. If I should be out when you call, speak to Johnny; y'll find him som'rs about."

"Can't say for sure that I'll be back," responded Mr. Blount, as he slouched out of the office.

"I can, I can," said old Peter, slyly, to himself, as Columbus tramped down the stairs. "In course he'll be back and give the mortgage, and get the money, and in six months he'll be back ag'in to beg off. But that won't work. If I had any idee he'd pay it, not a cent would I lend him. But I'll have that shop, land, tools, and all, before long, if he gives a mortgage. It's only a year since old Blount died, and that slipshod loafer of a son has let the business run down, till he can't make expenses out of it, after it's all paid for. It's surely worth $5,000, and I'll put a man in with some git-up-and-git, who'll soon make it net me a couple a thousand a year. That's what's comin'. So, young feller, just give me the mortgage, and it's as good as though I had it in fee-simple."

Peter Pinch chuckled mightily, as he writhed his face in hideous contortions, which all the town knew expressed his extreme satisfaction.

Columbus Blount did not have the easiest kind of a job getting his sister's consent to giving a mortgage. Matilda did not know much about such matters, but she was not entirely satisfied with her brother's administration of the affairs of the shop. Her father had toiled year after year at the smithy, until, when the railroad came, he branched out into the machinist business. He had worked hard and managed wisely, and in four years had equipped the shop with all the tools considered necessary to a country machinist, besides building a new house for his family, consisting of his wife, his daughter Matilda and his son Columbus. When he died he left the shop jointly to his son and daughter, the former being expected to operate it, following in the footsteps of his father, and support his mother and sister. But Columbus was hardly a good copy of his prototype. All he had ever discovered were the best places to loaf and hunt, and the fact that people will not long take worthless jobs out of respect to the bungler's parent.

Matilda was an industrious, intelligent girl of nineteen, who enjoyed a high reputation for her beauty as well as her amiable disposition. She had learned the printer's art at the office of the Valleytown *Vindicator*, and it was well for Mrs. Blount that she had done so, for the only revenue of the house, since Mr. Blount's demise, was from the earnings of Matilda. The girl did not complain, but she hesitated to incumber the shop with a mortgage.

Columbus, however, put as plausible a face on his unreasonable request as he could, and by profuse promises and various specious representations secured the signature that caused the transfer of $700 from the pocket of Peter Pinch to his own.

But instead of laying it out to the advantage of the business, young Mr. Blount paid some pressing creditors and went on a three weeks' hunt, which, with him, implied a spree also.

The six months passed, and the prophecy of old Peter Pinch was fulfilled. Columbus had, he averred, a great lot of collections to make right away, and could easily pay it up, if granted a short extension. This old Peter cared very little for, and stoutly demanded his money, which he knew could not be raised, or the shop.

On the day of the crisis in affairs, Matilda went down to the shop. Old Peter was there, bristling and aggressive, and so was young Blount, sulky and defiant. Matilda made particular inquiry into the business, asking her brother to explain why things had not turned out as he represented. When pressed too closely for a proper account, he gave her abuse instead of information. Matilda saw that the money lender was determined to have the place and that her brother had reached the end of his rope.

While the two latter were quarreling in the office, she slipped into the shop and went over to where the foreman, Larry Neil, was at work. Larry was a bright lad of about twenty-three, who had learned his trade there and knew much more about the business than his superior. Although he had never overworked himself, his supervision had been the only factor of safety in the workings of the concern.

"Mr. Neil," said Matilda, "do you think you can run the shop, so far as the work inside is concerned?"

Larry looked up at her troubled, but pretty face, and replied: "I don't know, Miss Blount. I think I can, if I have the necessary material. We haven't had what we needed to do with. When your father was alive, supplies were always furnished as quickly as asked for, but it hasn't been so lately. That's the principal reason why work isn't done properly and in time. I don't want to say anything against your brother, but with the right management I don't see why it can't be done. There's plenty of work, if people thought it would be done as ordered."

Matilda thanked him and returned to the office, just as Columbus blurted out: "Well, take the ——rattle-trap. If you can get anything out of it, you'll do more than I can."

"All right," squeaked Peter. "Come over to the Squire's a minute and I'll relieve you from paying it." His hand went eagerly to the door-knob. as he spoke.

"Not just yet, Mr. Pinch. I want to talk to you," said Matilda.

"Money's the only thing that'll talk to any use," jerked out the usurer.

"Now, Mr. Pinch," proceeded Matilda, "I want to say that I do not like to see this place go. Excepting a house and lot, it is all my mother and myself have. It is right that you should have your money, of course, but I want my chance now to save it. Give me six months time and I will try and pay it myself."

The old man stared in amazement at Matilda, who stood there, her hand on the desk and her cheeks flushed, the picture of resolution.

"You, girl; what'll you do with the shop?"

"Run it, and pay you up, if possible," she replied. "Columbus will, of course, after abandoning it, sign his interest over to me, and I will assume the whole. The shop will not run away. You will be well secured and will get your interest, at least. You do not want to be considered illiberal with a widow's child, do you?"

"N—o, nor am I. I only ask what is my due. I can't see how I can let things run any longer. You'll make it worse and worse, perhaps get rid of the stuff and then, where'll I be?"

"You can watch it as closely as you like. Now, Mr. Pinch, don't have it said that the oldest deacon in the church refused to give a girl a chance to save her only property, when she has a mother to support. It may be that I can't pay you, but be charitable, for the sake of your religious profession."

Deacon Pinch had made up his mind not to lose an hour in seizing that shop, but this shrewd appeal to a virtue he professed to possess, was not without effect. He finally did extend the note three months, with interest at double the usual rate. He felt positive that this accommodation would only put off his acquisition of the shop three months, while giving him a favorable advertisement, which his reputation badly needed.

Columbus Blount was induced to sell his interest in the shop to his sister, the twenty five dollars consideration, which Matilda paid out of her earnings, being the only argument that carried any weight with him. He then cleared out.

On a fine Monday morning in September, early passers-by noticed two young men hanging a new sign in place of the one that had depended from an iron rod on the front of the local mechanical mecca for twenty years. The new board bore the interesting words: "Matilda Blount's Machine and Blacksmith Shop."

The fair proprietress, whose business was thus advertised to the town, was in total ignorance of the manner in which she had been brought to public notice, until the villagers began to compliment her upon her brave stand against impending ruin, adding, usually with a broad smile, that they hoped her new sign would draw many customers.

Matilda always arrived at the shop before the whistle blew for the commencement of operations for the day. This had the effect of bringing the machinists and employes down on time, which had not occurred for many months. They had been in the habit of straggling in between half-past seven and eight, the boss never being on hand to note the time lost. This was a good beginning. She assured all the patrons who came that the work would be properly done, and saw that it was delivered when promised. She could not superintend affairs in the shop, but she kept the accounts and knew everything that was going on, trusting the operations inside to the skill, good management and honesty of Larry Neil.

As previously stated, Larry had been a good natured, willing, happy-go-lucky sort of a youth, who had never felt much responsibility, but had always given fair service. A few days after Matilda took the reins in her own hands Larry was heard to say that, "he'd be —— if he wouldn't pull the girl through, if it was a possible thing." He had justly complained of a lack of facilities for certain work, but when he came to make out his requisitions he said nothing about the greater part of what he had claimed was necessary. Nor did the jobs fail to be done. He was ingenious by nature, and now that he took an interest in turning out whatever came, he readily rigged, patched and improvised in such a way as to accomplish the end. Many evenings he remained till daylight had departed, getting things in proper shape for the apprentice to do a man's work.

It was a slow town, but the good people, after a season of head-shakings and doubt, began to realize that it was their duty to help along the quiet, unassuming, stout-hearted daughter of their old neighbor, by sending their work to her shop instead of having it done at the next largest city, as they began to do soon after Mr. Blount died.

Still, they were a long while in deciding and longer in taking action thereon, and the weeks multiplied into months so rapidly that the great and terrible day, when the mortgage must be taken care of or the shop lost, was near at hand before their good intentions came to fruition. It was a large amount to raise from a business so badly demoralized, and would have given the venerable Mr. Blount a hard rub, in his best times.

But the shop went busily on, day after day, regardless of the dread incubus. Matilda and Larry worked with a will doing the very best that lay in their power. They seemed to make a first-rate team, Matilda keeping strict account of the finances, and Larry of the work in the shop.

One afternoon, a few days before the note fell due, the proprietress and her right hand man were in the office, their heads bent over the same table, conning a batch of shop reports, from which charges were to be made. The old smith, taking his two and-a-half-inch pipe from his mouth, pointed at them through the window in the office door, and said to a machinist: "D'ye see that, Jimmy? Now, I tell ye, them heads is too clus tegither for ornery. That Larry, he hain't wurked like a prisoner gitten' out a jail, night an' day, jes becase he's paid wages. He's got an interest in that gal, that ain't hard to diskiver. What'd I hear 'im sayin 'last Saturday night but that he'd take his pay when the mortgage wis h'isted. Now, you min' my words, it means somethin'." The old man winked knowingly, and seemed mightily pleased with the probability he suggested.

"But," he added, "the note is on the road, an' 'll be here in jes four days. Mayhaps we'll all be out of a job then. Can't tell, can't tell."

(To be continued.)

THE ENGINEER'S CHRISTMAS.

[Concluded.]

The superintendent duly arrived at a town in West Virginia, and went directly to St. Mark's Hospital. He had received from the Mother Superior of that institution a description of a girl in their possession which tallied with that of Ruth Weston. He now learned that the young lady, who turned out to be the one he was looking for, had been landed at that place from a river boat, which had rescued her from the stream the day after the Johnstown flood, at a point nearly a hundred miles below that ill-fated town.

For many months she was confined to the bed, unable to relate her history. When her health and reason were restored sufficiently to give an intelligent account of herself and her misfortune, an effort was made to find her mother and fiancee. It was learned that her mother had died, but it chanced that none of the persons of whom inquiry was made knew of Bill Jameson—whether he was dead or alive. Superintendent Pierce saw a notice of the mysterious ward at St. Mark's in a local paper, which had in some manner drifted into his hands, and this was his first clue.

At the time he visited the hospital, Ruth was quite restored to health, but of course, was suffering much on account of her sad bereavement. Mr. Pierce told the Mother Superior about Bill being his engineer, and it was arranged that Ruth should leave with him, under the impression that a situation, in which she could take care of herself, had been found for her. So they left that evening and the next day arrived at the home of Mr. Pierce.

Bill had been asked to attend a supper, to be given by the superintendent on Christmas Eve, and only after much persuasion did he agree to go. Of course, he got shaved and put on his best clothes, and there was not a more presentable person in town than Bill, on that evening.

When he had been ushered in, Mr. Pierce took him to one side and told him that he must be prepared for a surprise, and a big one. This however, he thought referred to something that was going to be done for the entertainment of the guests.

Mr. Pierce arranged the matter well. He seated Bill before a fire-place burning natural gas, in an up stairs room, and they smoked cigars and chatted for half an hour. There was no light in the room other than that made by the fire, and it had been arranged to turn off the gas slowly so that it should become too dark, after a time, to recognize anyone who might enter the room.

While they were talking Mrs. Pierce and Ruth came in and looked out of the window at the tongue of flame sent up by a neighboring furnace. Presently Mr. and Mrs. Pierce were called and, excusing themselves "for a moment," went down. The gas was then turned on full blast.

About two minutes after the illumination, a short, subdued scream was heard, and then all was silent.

* * * * * * * * * *

The good parson was a guest that evening, and his services were needed. When he had pronounced the solemn words that had been so long and cruelly delayed by the awful Johnstown flood, and had placed on the bride's finger the ring provided the groom by his friends, he turned to the happy engineer and said, "Please consider this the Christmas present of Mr. and Mrs. Pierce, and (placing $500 in gold in his hand) this the lump of coal saved at the mill by economical, intelligent firing, and may it keep your hearth warm for many a day."

And if the words of the superintendent had not come true, there must have been many exceedingly happy men in the State that Christmas Eve.

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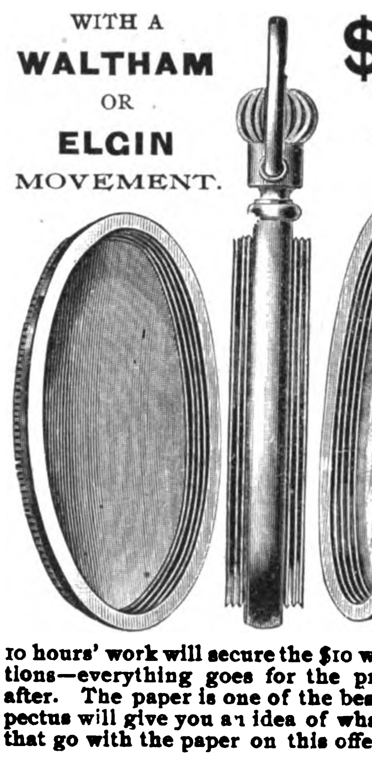

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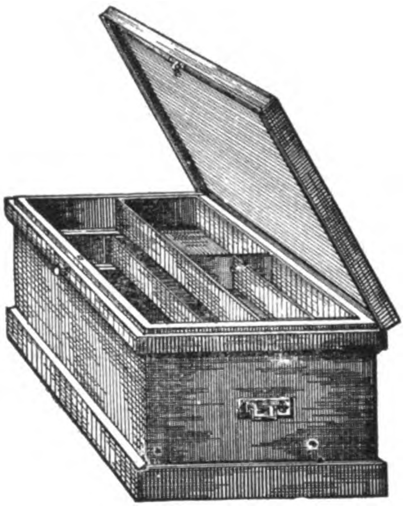

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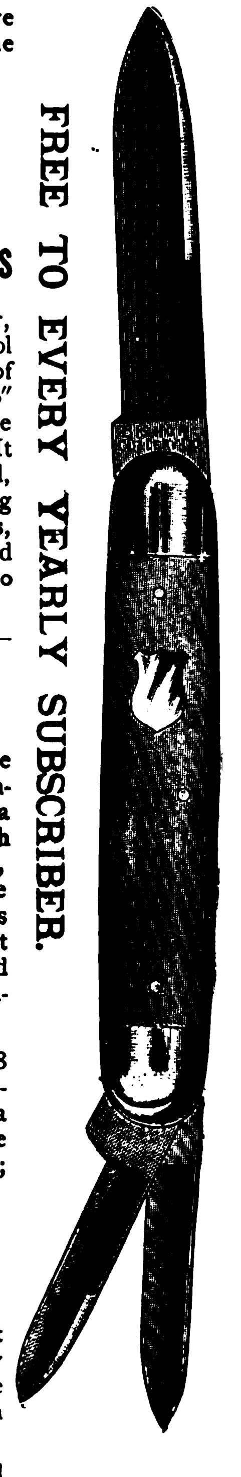

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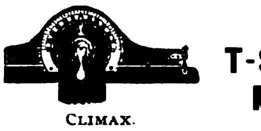

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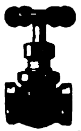

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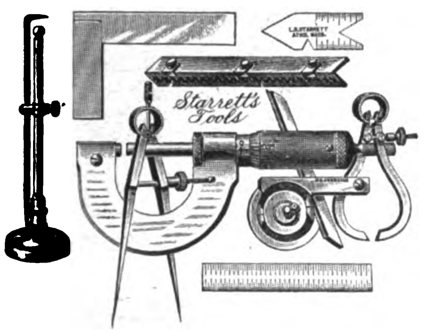

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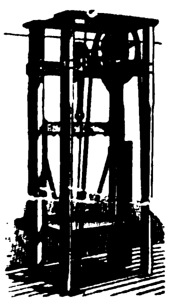

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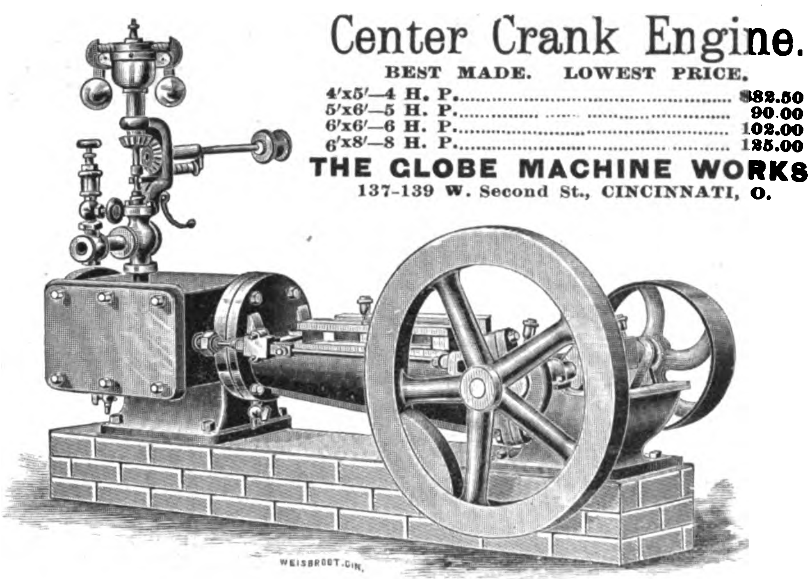
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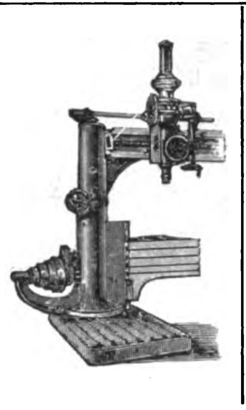

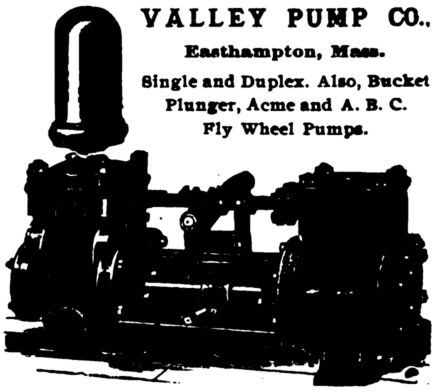

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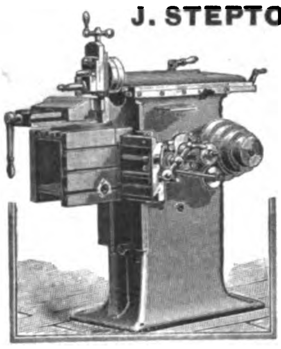

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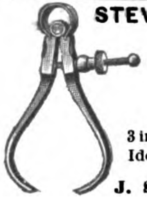

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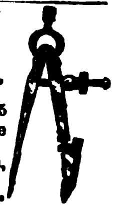

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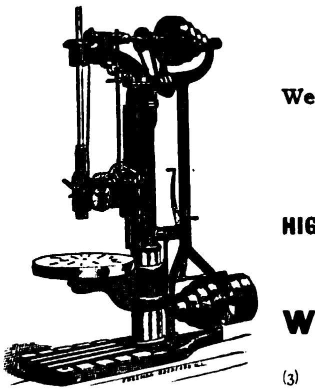

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VOL. X.—NO. 2. CLEVELAND, O., JANUARY 15, 1892. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. TERMS:—$1.50 A YEAR, SINGLE COPIES, 7 CENTS

CONTAMINATED WATER.

The necessity of having pure water for drinking purposes is now universally admitted, and great care is taken to insure the purity of the supply, especially in cities where the problem is more difficult than in the country. The same care is not always taken to insure purity in the supply used for boilers, and the result is that repairs and delays often result, which are always annoying and often expensive. It frequently happens that a source of water that was sufficiently pure at the outset becomes contaminated in the course of time by the gradual and progressive accumulation of sewage and other organic matter in the soil through which the supply comes. This is particularly true of wells. The trouble that such organic impurities may give rise to is shown by the cuts in the present issue, which illustrate some of the many cases of this kind that we meet with in our work of inspection.

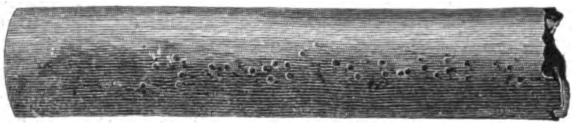

FIG. 1—A PITTED TUBE.

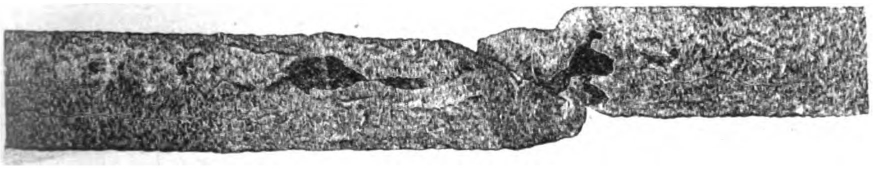

FIG. 2.—TUBE CORRODED BY CONTAMINATED WATER.

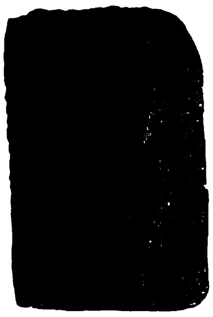

FIG. 3.—A CORRODED PLATE.

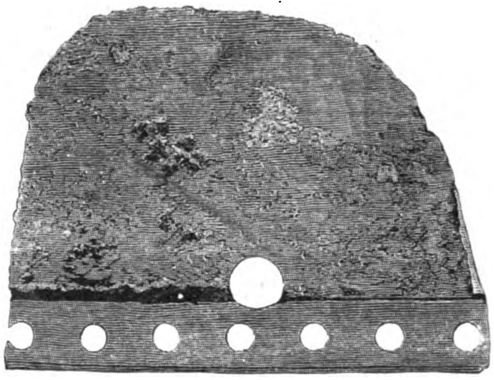

FIG. 6.—A GROOVED AND PITTED PLATE.

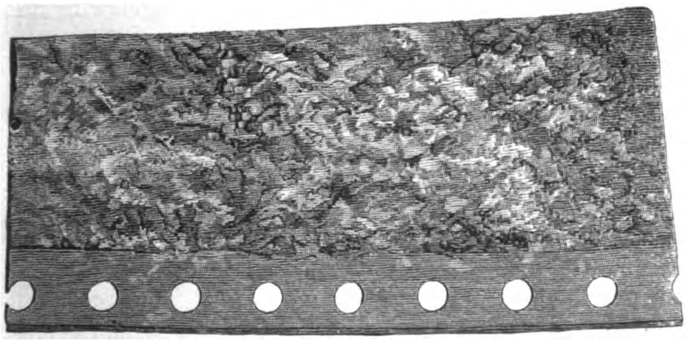

FIG. 5.—A BADLY CORRODED STEEL PLATE.

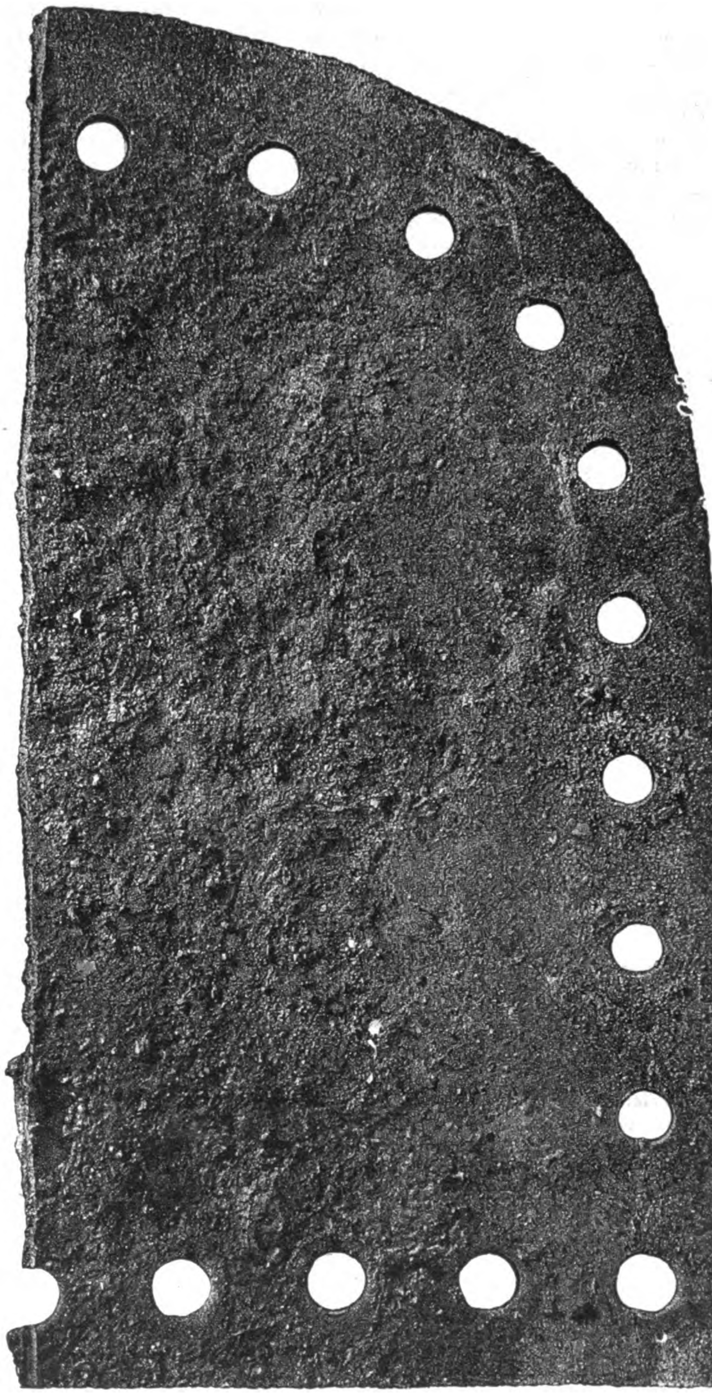

FIG. 4.—SHOWING THE CORROSION OF A PATCH IN USE ONE YEAR.

Fig. 1 represents a portion of a tube that was taken out after three weeks' use. The boiler from which it was taken had some scale on both tubes and shell, but not enough to give trouble. The feed water was taken from the city service, and was supposed to be the same as that used for domestic and general purposes. The trouble in this instance first showed itself by the leaking of the tubes; and on removing the leaky tubes to put in new ones it was found that they were badly pitted, although no evidence of pitting had been seen at the inspection some eight months before. The tube shown in Fig. 1 was one of the new ones, and, as has already been said, it failed in about three weeks, and others that were put in at the same time failed within a month. The trouble was evidently with the water, the new tubes giving out more quickly than the old ones, because the scale on the old ones protected them to a considerable extent. It could not have been with the quality of the tubes, as three different makes were tried. Upon investigation it was found that well water was used about the establishment for mechanical purposes, and upon tracing out the pipes it was further found that the city service pipes and the pipes from the well were connected. The valves on the connecting pipe were supposed to be closed, however, the connection having been made so that feed water could be obtained from the well in case of an emergency, such, for example, as the temporary shutting off of the city service. It was then discovered that on account of the failure of a valve the water pumped from the well found its way into the receiving tank from which the boilers were supplied. The pipes to the well were then disconnected entirely, and the trouble ceased. The vicinity of this well had

[Continued on page 5.]

BOILER-MAKING.

This much abused subject fails to receive from scientific and high class mechanical minds the attention to which it is entitled. Yet it is, in a great measure, the most important subject to which the enlightened minds of to-day should give their greatest thought, from the fact that within the boiler and the boiler-room, lie stored the reserve forces, which, through careless, ignorant management can be used not only to destroy the labor of the architect and builder of the edifice enclosing it, the wealth of the owner or owners of the mill or factory, but the lives and limbs of the employees who use the power of the latent force to develop the best results of the machinery on which they are employed.

In addition to these factors it is a well known fact, that the true economy of the steam engine consists in the care used in the fire-room by the man in charge of the furnaces, as coal can be wasted to an unlimited extent when handled by the novice, while the expert fireman can save much more than his salary by judicious application of fuel "at the right time and in the right place."

The construction of a steam boiler to-day is not of the same difficult nature it was thirty or forty years ago, as the spread of education has increased the knowledge of the younger minds who have entered the boiler shops or yards with a desire to make that a life business, and this knowledge now enables nearly all boiler shops to command the services of intelligent young men with an understanding of mathematics and geometrical formula unknown to the older workers in the field. It is a deplorable fact, however, that notwithstanding the opportunities presented to manufacturers, still many, especially of the old school, prefer to continue in the methods of their younger days and early training than avail themselves of the brainy young talent which can now be had when necessary. As a consequence many boilers are still ill-proportioned and braced without any due regard to the requirements of duty to be performed; with tubes so spaced that not more than one-half of their surface can be depended on as available and no attention paid to the most important part of economical boiler duty—circulation.

The boiler manufacturer is not entirely to blame in this matter, as part of the responsibility should be placed on the shoulders of the purchaser or user. They do not look for brains or talent in the boiler shop or boiler yard—to them a boiler is a boiler, no matter how it is constructed or of what material, and as a consequence the old fashioned manufacturer is encouraged to persist in his theories of proper boiler construction.

It is not to be understood that the words "old fashioned" or "old methods" are intended to refer to the mechanical skill employed years ago in manufacturing a boiler, where all rivets were driven by hammers and the calking done in a scientific and mechanical manner by the old fashioned calking tool. Now the machine or "snap" takes the place of the riveters and the air compresser furnishes the power necessary to calk the boilers and set the tubes. In none of the mechanical arts has there been less actual improvement in the last twenty-five years, than in the construction of steam boilers, and to-day it is the men who have never worked in a boiler shop who reap the fruits of ignorance displayed by the short-sighted, grasping manufacturers of the new and old school who, by their shiftless methods of construction and ignorance of the requirements of economical duty, laid bare the field to brainy men outside of the business to introduce and perfect safety and non-explosive boilers, which year by year are more generally being introduced at a far greater original expense than the old style boiler, but which, at the same time, possess the singular merit of cheap service, safety and durability.

Still, some of these so-called "improved boilers" possess no merit whatever outside of economy in fuel, their durability being less than any of the old fashioned styles, while the item of repairs justifies the assertion that the man buying one of such boilers needs also to buy a workshop with it. Yet they sell, for the simple reason that the inventor or agent will guarantee a greater evaporation per pound of fuel than that possible from any other boiler made, and while the boiler is new and under the most favororable circumstances can demonstrate the justice of his claim. The boiler being paid for the responsibility ceases, and the future expenses make up more than the difference in price to the unfortunate owner.

These remarks do not apply to all of the patent boilers. Many of them have a well-deserved reputation for durability, safety and economy, but their success has led to the introduction of "man traps," under the guise of the better styles, approaching the really better boilers so close in general construction as to lead the ignorant public to believe that they are of similar design and construction to their more worthy competitors. At the same time care is manifested not to infringe on the patent rights of the original manufacturers whose work is imitated.

Good boilers of the old types are still made and give most satisfactory results, but there is in many minds a prejudice against all boiler manufacturers, owing to the faulty construction and dishonest methods pursued by some still in the business. It was hoped that the organization of the American Boiler Manufacturing Association would lead to a system of uniformity, both in quality of material and general construction, which would tend to remove the suspicions against boiler construction and boiler makers, as it was supposed from the articles of association that such was the intention of the promoters of the organization. Unfortunately for the hopes and expectations of those most interested, the second meeting of the association was used by part of the membership as a means to organize from the parent body a boiler insurance company to compete with such institutions as were already in existence for that purpose, and the agitation of such a subject, premature as it was, caused a feeling of reaction to take place, driving many of the best wishers and most active workers for reform in boiler construction in retirement, where they will probably remain until the right spirit is manifested and intelligent action be taken toward a reorganization of the association on the old line of progress, than which none better can be adopted.

At the last meeting of the A. B. M. A., at St. Louis, a stirring programme was introduced and unity of sentiment prevailed. Unfortunately this meeting was but poorly attended, and the proceedings did not arouse the enthusiasm they deserved. One of the best measures brought before the meeting was that of a general inspection law, to be introduced as far as possible (subject, of course, to modification where necessary) to the Legislatures of the several States at their next session, but it is very doubtful if the measure will receive the attention it deserves, as few of the members take interest enough in the association at present to spare the time, trouble and expense of agitating the measure in State councils.

There is a vast field for improvement, and it is to be hoped that the brains and talent of the boiler-making fraternity will agree on some plan whereby the craft may be improved, the quality of construction and material advanced and the foundation laid for a higher degree of excellence than has hitherto been reached in this very important industry.

CALKING TOOL.

SCIENTIFIC NOTES.

An improvement in the preparation of lubricants is described by Krause, a German chemist. The soap formed by treating wool grease with alkaline lye is dissolved in water and filtered, and to this a solution of alum or other alumina salt is added, the result being the formation of a brown precipitate, and this is called aluminum-lanolate. With this substance, when dried, lubricating oils of any degree of viscosity desired may be produced by dissolving it in any fluid mineral oil. It is also found that, if dissolved in a small quantity of mineral oil, a gelatinous substance is obtained which may with considerable advantage be mixed, in suitable proportions, with India rubber or gutta-percha. Solvents for India rubber are said to be also solvents for aluminum-lanolate. In textile industries this substance may be used as a scouring agent.

One of the new names in practical engineering chemistry is that of paranitrophenol, and it may yet play an important part in a certain specialty. As is well known, water containing magnesium chloride is injurious to boilers, as the salt dissociates with the production of hydrochloric acid which attacks the plates and though, in large installations, where systematic purification of the feed water can be adopted, this evil is preventable, in most cases the treatment in vogue consists in adding caustic soda to keep the contents of the boiler alkaline; an excess of the soda, however, is wasteful, as well as otherwise objectionable, and it becomes desirable to ascertain readily when the water in the boiler ceases to contain alkali and needs a further supply. Dr. Goldberg has found that the sodium salt of paranitrophenol is entirely unaffected by the salts, commonly present in feed waters—the claim being that it is possible, by introducing a sufficient quantity into the boiler, to judge of the alkalinity or acidity of its contents at any given moment by merely blowing the water out of the gauge glass and allowing it to refill. To give a distinct yellow color—the evidence of alkalinity—to the water, so that it may be seen in the small quantity of water in the gauge glass, about thirty to fifty grammes per cubic metre are requisite. It is remarked that, though the high price of the article is a bar to its general use at present, still, as its successful application is not dependent on its purity, a crude variety could doubtless be produced much more cheaply.

The long-time desideratum among machinists and engineers for a good steam motor of simple principles, capable of high speed, and not requiring management by an expert hand, is believed to be realized in a recently devised apparatus described as follows: The cylinder is contained in a cylindrical casing, which rotates in the short arc of a circle as the crank turns, and by so doing opens and closes the ports, thus practically dispensing with the services of valves. A rigid piston rod is, of course, utilized, and the bottom of the casing in which the machine is enclosed is filled with water, floating a layer of oil, into which the crank is dipped at every revolution. These engines are made in sizes ranging from two to 15 horse-power, and some of the smaller ones can be run at 2,000 revolutions per minute. The engine can be suspended from a beam like the hanger of a shaft.

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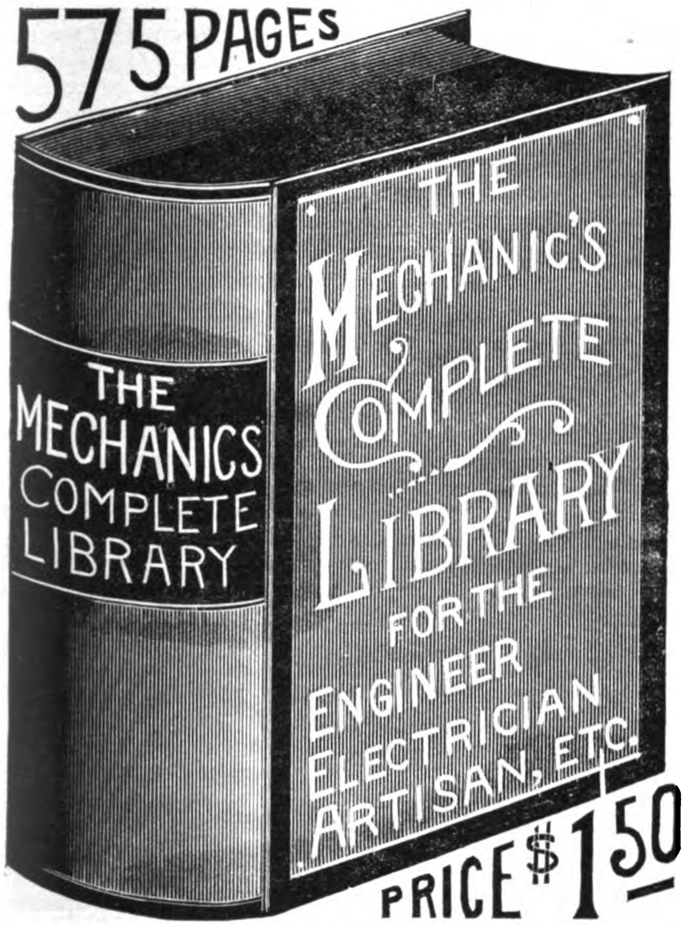
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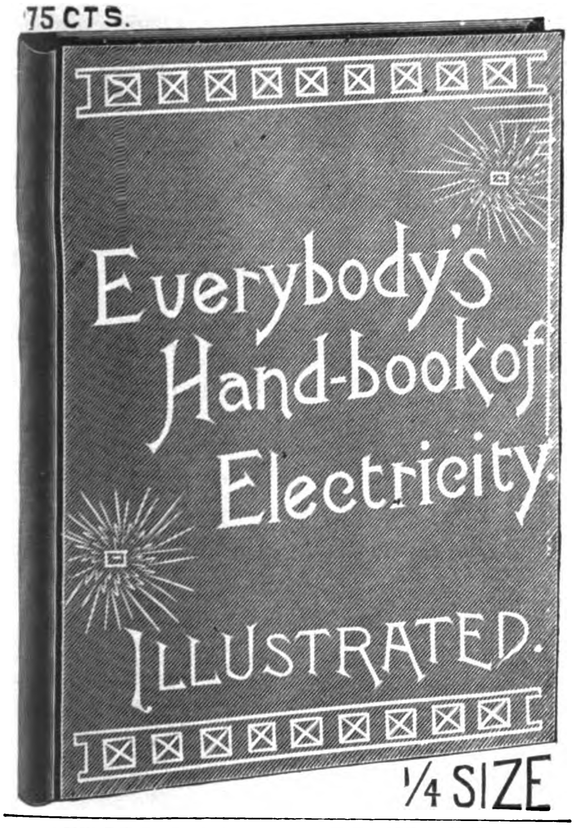

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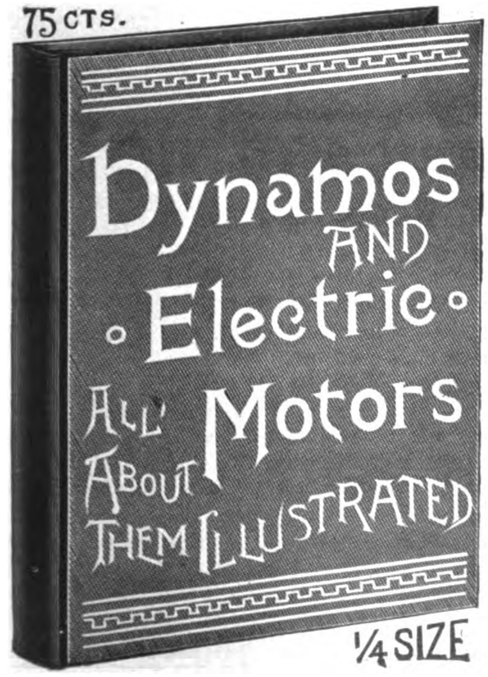

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SELF RELIANCE.

Now that the holidays have passed and the Winter has settled down, the elements that disturb private work and thought have largely taken their departure and time is available to do some good work in education. The various associations of engineers which have not already done so should prepare a programme for the Winter and see that it is carried out creditably and profitably.

Time was when it was thought that nothing in the nature of lectures or papers could be had without the presence of some of the well known writers and lecturers in mechanical subjects. That time is no more. There is not an association on the United States that does not number among its members men who are capable of preparing papers that will prove very helpful to the knight of the throttle. They may not be able to take high mathematical and scientific flights, but still that is not to be deplored and may be a decided advantage, for it is practical knowledge imparted in a plain, every-day manner that the engineer profits by the most.

We do not wish to disparage lectures by men of reputation who may be induced to come. Every effort should be made to procure as many as possible. But the engineers will get a decidedly advantageous lesson when they learn to rely largely on themselves, and the means at hand for advancement. If every man in an association should be compelled to prepare a paper on some topic pertaining to the operation of steam plants, the effort of doing it, the thought necessary to the preparation of any sort of a composition, be it ever so poor, would be found to be of more help to each individual than the finest lecture he could listen to. It is the activity of the mind that improves the man, and it must be acknowledged that some will not exert their minds while listening to a lecture sufficiently to understand it, and profit by it.

Let no association be discouraged because the facilities formerly considered necessary for a series of meetings in which papers are read, are not at hand. But let them depend upon themselves, and they will find that they have all the facilities they require.

WE are often asked how a young man can learn mechanical drawing without an instructor. We refer all readers who wish some information of this kind to the advertisement of Henry Carey Baird & Co., found in our advertising columns. The work of Rose on mechanical drawing is there mentioned. There are also other books by the same author described. Joshua Rose is one of the most famous mechanical writers of the world. It will well repay any reader to send a card and get the catalogue of Henry Carey Baird & Co.

IT has been demonstrated that gun metal is the best for steam. It is therefore a superior articles for valves, as by simply regrinding the disk, or in any case by having the disk replaced, it can be made as good as new. The celebrated Lunkenheimer Brass Manufacturing Co., of Cincinnati, O., makers of standard valves, are having great success with their valves made of gun metal. They warrant them to outlast two of other make. Their address is 25 E. 8th St., Cincinnati, O. If you write them, it will be to your advantage to mention this paper.

Electrical

☞ *The Electrical Lessons recently printed, one of which gave directions for making a dynamo, will soon be completed, when the whole series will be published in a neat volume with paper covers. Every one subscribing after December* 1*st*, 1891, *will receive a copy free. This series constitutes the simplest and best instruction for beginners we have yet seen.*

History of Generators.

About the year 1831 Faraday began a series of experiments on the subject of induction of electric currents. One apparatus which he used embodied some of the principles of the modern electric machines. As will be seen from Figure 1 this machine consisted of a permanent horse shoe magnet mounted on but insulated from a standard. Near this magnet on a support of sufficient height to bring its axis on a level with the magnet, is a disc arranged so that its rim may be revolved between the prongs of the magnet. The disc is not insulated from its support but makes connection through it to a binding post on the base board. On the base board immediately under the magnet is another binding post, and connected with it is a strip of soft metal extending up to and rubbing against the rim of the disc as the latter is revolved. Faraday found that on revolving the disc, a slight current was set up in the circuit between the two binding posts, its direction depending on the direction of rotation of the disc.

Not long after the discoveries of Faraday, Pixii took advantage of the facts revealed and constructed a magneto electric-machine, in which two electro magnets having soft iron cores were attached to a frame or support, and before the ends or poles of these magnets was revolved a permanent magnet, thus creating an alternating current in the wire around the magnets. By alternating we mean changing from positive to negative and negative to positive as the poles of the permanent magnet change position. These alternating currents were changed into a continuous flow by means of the commutator, which consisted of a couple of rings of metal, across which the current was passed by means of sliding contact with strips of metal, or brushes as we now call them. These rings were so cut and insulated that when a positive current was flowing through one electro-magnet, it was taken by one ring and passed out through the circuit and when the permanent magnet had changed its position so that the electro-magnet referred to had a negative current passing through it, then the commutator had also changed so that another ring received the current while the first commutator ring named took the positive current from the second electro-magnet. Thus the current was changed and sent in one direction. Figure 2 shows the form of the Pixii machine.

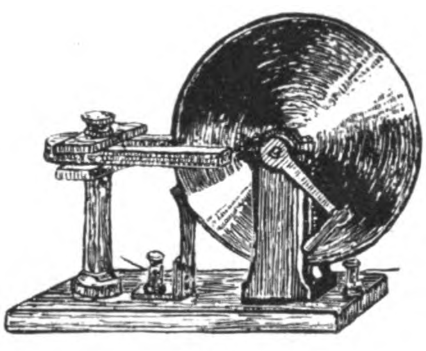


FIG. 1.

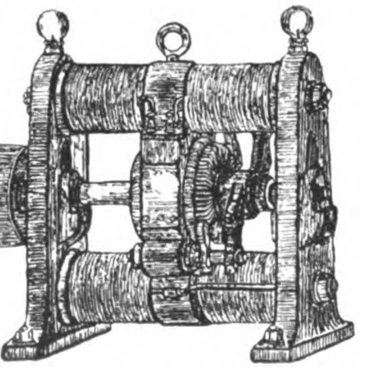
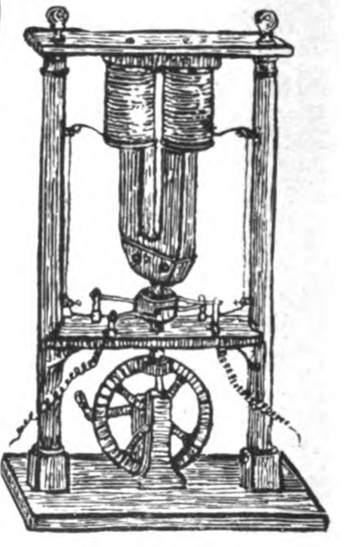


FIG. 3.



Pixii Magneto Machine

FIG. 2.

Later, Pixii's machine was modified by arranging it so that the electro-magnets were revolved instead of the heavy permanent magnet, which was then fixed and the electro-magnets were revolved laterally, this idea being suggested by Clarke. Then naturally followed an increase in the number of coils so as to obtain a stronger current, and later the adoption of electro-magnets for the field instead of permanent magnets. This latter idea was the conception of M. Wilde. At first it was thought necessary to excite the field magnets by a current from a small machine with permanent magnet field, but soon it was found that the fields could be properly excited by the current produced by their own machine, thus applying the principles explained by Werner, Sieman, Wheatstone and others some time previous.

Mr. Gramme seems to have been among the first who succeeded in utilizing fully the discoveries referred to. He, by ingenious combinations, adapted them for the supply of a fairly steady electric current. One of the early forms of Gramme machines, as will be seen by Figure 3, is somewhat similar in appearance to dynamos of the latest types.

Space will not permit mention at this time of the apparatus of Pacinotti, Siemens, Thomson, Ferranti, DeMeritens, Gordan, and other notable pioneers in the electrical field, whose experiments have contributed so largely to the advancement of electrical science. E. M. F.

SERIES OF NUMBERS WITH EXAMPLES OF THEIR PRACTICAL APPLICATION TO SCIENTIFIC PURPOSES.—III.

We might arrange the logarithms given in our last issue in the form already adopted for series of numbers, thus:

A. P.	0	.301	.477	.602	.699	.778	.845	.903	.954	1.000
G. P.	1	2	3	4	5	6	7	8	9	10

although it must be noted, that when so placed, they do not form *complete* series of numbers in regular progression, as neither the arithmetical nor the geometrical rates of progression are observed—many of the numbers being intermediate ones intended merely to give the logarithms of the first ten numbers. If taken conjointly, however, it will be found that all the properties of series of numbers given in our first article belong to them, and that the operations of multiplication, division, etc., as described, may be readily performed by their means.

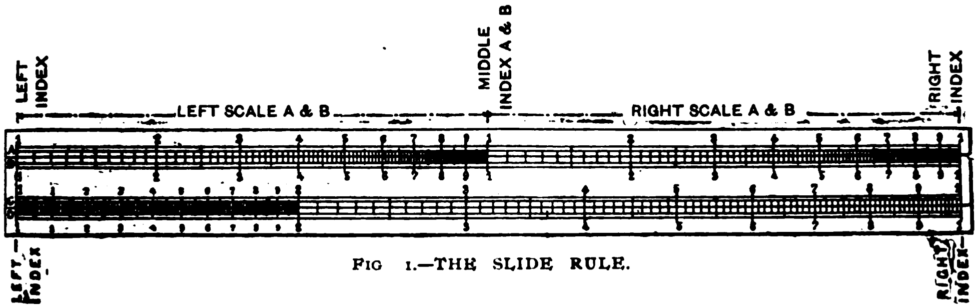


FIG 1.—THE SLIDE RULE.

The first and simplest application of the principles set forth which we shall now notice is that which is to be found in the slide rule.

If we take two strips of paper 10 inches long, each divided upon one edge into 1,000 equal parts, and if against the starting point or zero of each we place the figure 1, then at the end of 301 parts we place the figure 2, at the end of 447 parts the figure 3, and so on, we shall have, as shown in Fig. 2, what is termed a logarithmic scale, the figures of which represent a series of numbers in Geometrical Progression, and the corresponding unequal spaces a series of numbers in Arithmetical Progression. It must, however, be borne in mind that these figures as they stand on the scale are not a perfect series of numbers in *G. P.*, neither do the unequal spaces represent a perfect series of numbers in *A. P.*; if we, however, eliminate the figures 3, 5, 6, 7, etc., we shall find that the remaining ones, 1, 2, 4 and 8 are in perfect geometrical progression, and that the spaces between 1 and 2, 2 and 4, and 4 and 8 are all equal, so that they are now in arithmetical progression. The equal spaces are subdivided, and the figures added to make a complete *scale*, but they do not in any way nullify the principles laid down.

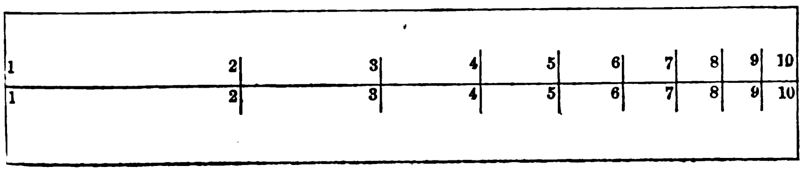


FIG. 2.

The practical application of the foregoing is effected by means of the following further general principle, viz.:

A *unit* may be represented by a SPACE of any length measured from a given point; and a *number* composed of two or more units may be represented by a DISTANCE composed of a similar number of equal spaces. These distances may be increased by adding or joining on to them other spaces or distances or decreased by taking from them some of the spaces or distance of which they are already composed.

If we now take one of the graduated strips of paper, and lay it lengthways by the side of the other one in such manner that the figure 2 of the lower strip coincides with the figure 1 of the upper one (as shown in Fig. 3), we, as it were, add on one space to each of the spaces of the upper scale, so that the coinciding positions on the lower scale give us the values of the upper scale spaces *plus* this added space. This is equivalent to the adding together of two numbers of an arithmetical series. But the *number* which we find on the lower scale is the product and not the sum of the two numbers whose spaces have been so added. Thus with the initial 1 of the upper scale placed against 2 of the lower scale, we find under 4 of the upper scale the figure 8 on the lower scale, which is the product of 2 and 4, and not their sum.

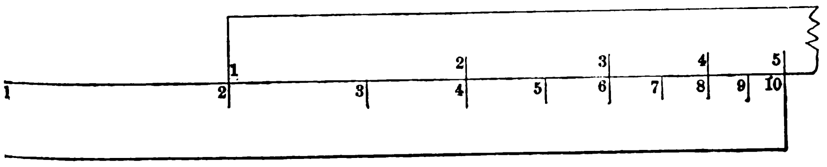


FIG. 3.

It will be also seen that the ratio of all coinciding numbers on the two scales is the same as 1 to 2, or as the ratio of the initial 1 of the upper scale to the number of the lower scale against which it is set. Similarly, if the initial 1 of the upper scale be placed against 3 of the lower scale, all numbers of the upper scale will be in the ratio of 1 to 3 to their coinciding numbers of the lower scale: whence, *place the slide of a Slide Rule as we will, all the coinciding numbers of the slide and the rule form equal ratios, whilst any two such ratios taken together form a perfect proportion.* The importance of this principle of ratios cannot be over-estimated when it is noted that it is the basis of the common arithmetical rules of multiplication and division, as also of that branch of Mathematics which treats of the relations of the sides and angles of triangles, or Trigonometry. Many of Euclid's propositions also show us that geometry abounds in ratios. Multiplication is but another form of the proportion $1 : a :: b : x$, and division is likewise reducible to the proportion $a : b :: 1 : x$. The sine, cosine, tangent, etc., of a triangle are also but the expressions of the ratio existing between two of the three sides of a right-angled triangle, this ratio always varying with the angle.

We can also with these two slips of paper perform calculations in Evolution and Involution; in fact, all the operations refered to in our first article may be effected by their means.

If now the spaces be decimally divided and subdivided, and if we attach to the initial 1 the value of any decimal part or decimal multiple of 1, we obtain a scale with which operations extending to many figures may be quickly and accurately performed.

Such are, briefly stated, the principles upon which the construction of the Slide Rule are based, one slip of paper representing the Rule, and the other the Slide. For further details we must refer the reader to our treatise on "The Slide Rule," in which the various rules for applying it to the solution of mathematical problems are fully given, as also demonstrations for working out a number of engineering and other formulæ.—[From The Compass, Keuffel & Esser, Publishers, and Wm. Cox, Editor.

[To be continued.]

CONTAMINATED WATER.

[Continued from 1st page]

been used as a dumping ground for general debris, and it also received drainage from the cesspools of adjacent buildings. It appeared to be somewhat affected, too, by a neighboring salt marsh.

The tube twisted and torn in removal (Fig. 2) was taken from a boiler that had been in use six months in a creamery. All the tubes were in much the same condition as that shown in the cut. The cause of the trouble was very evident in this case, as the feed-water was taken from a well into which the drippings from the creamery percolated.

A good illustration of the progressive contamination of water is offered by the boiler from which the pieces shown in Figs. 3 and 4 were taken. Fig. 3 shows the first observed evidence of an attack on the shell, though during the previous year the tubes had shown signs of failure, and several had been taken out. For the first four or five years, however, the boiler had shown no deterioration, though some scale was deposited in it; but as the soil through which the water supply came to the well became more thoroughly saturated with organic impurities, the corrosive action became more severe. The piece shown in Fig. 3 was cut out, together with a portion of the adjoining plate that was also affected, and a patch was put on. Fig. 4 shows one-half of this patch after it had been in use one year. The water had grown continually worse, and deterioration progressed most rapidly, especially on the new plate, which was unprotected by scale. The water supyly was changed, when the condition of the patch became known, and the destructive action ceased.

Fig. 5 shows a section taken from a steel boiler that had been in use only two years. A lime scale formed on the plates and tubes, and gradually settled down on the plates as a sludge. Although the coating so formed was not thick or hard, the salts of which it was composed were active in producing corrosion, and the whole bottom of the boiler was destroyed. The feed-water was taken from a well, and it had been in use for many years without showing any corrosive action. The older boilers in the battery had been protected from the water to a considerable extent by scale, though subsequent examination of them showed a slight indication of the same trouble on some of the plates. By the time the new boiler was put in the water had become so impregnated with the impurities in the soil that the clean surface of metal was attacked vigorously.

Fig. 6 shows a case of grooving along a joint, arising from the same cause. The entire lower half of this boiler was destroyed. The feed-water was taken from a well, which had formerly furnished the best of water, since it had a rock bottom and was fed directly by a spring. It was definitely known that the shell was free from pitting and corrosion on a certain date, the tubes having been removed for examination. The same year a sewer was built in the neighborhood and the spring that had supplied the well was cut off, so that surface drainage had to be relied upon thereafter. The result was that the new supply, percolating through soil already saturated by outhouses and cesspools, was of so different a character that it was not only unfit to use, but positively dangerous.

A great many other examples of the action of contaminated water could be given, as we meet with them continually in our practice. No certain rule for avoiding its dangers can be given. The safest thing that can be done is to watch the boilers carefully, and if signs of trouble are perceived, a purer supply of water should be secured. An apparently slight source of contamination may give rise to serious trouble, especially in new boilers. The carbonate of ammonia produced by the fermentation of urea in outhouses is particularly destructive, and care should be taken to keep feed-water from being contaminated with it.—[From the Locomotive, through courtesy of J. M. Allen, editor.

THE DEVELOPMENT OF THE STEAM-ENGINE—III.

BY PROF. R. H. THURSTON.

James Watt.

The merits and demerits of the Newcomen engine were those characterizing a novel and radically altered form of machine, which was the first of a new type; that which may be called the modern type of steam engine. A complete revolution had been thus effected, and the genius of the great inventors had produced a more complete and thorough change of type than had been previously seen, or even than has ever been since effected by even Watt and his contemporaries and successors. It may then be said that, defining the steam engine as a train of mechanism, Newcomen and Cawley were its inventors, and that their machine was the first steam engine. The invention of the modern type of steam engine is to be credited to them, and not to any of those later inventors who simply improved upon it in matters of detail. In this respect Newcomen ante dates Watt.

Comparing the engine with those preceding it, we see that at first we find a single vessel performing the functions of all the parts of a modern pumping engine; it was at once boiler, steam-cylinder and condenser, as well as both a lifting and a forcing pump. The Marquis of Worcester, and, still earlier, Da Porta, divided the engine into two parts; using one part as a steam boiler, and the other as a separate water vessel. Savery duplicated those parts of the earlier engine which acted the several parts of pump, steam-cylinder, and condenser, and added the use of the jet of water to effect rapid condensation. Newcomen and Cawley next introduced the modern type of engine, and separated the pump from the steam-engine proper. In their engine, as in Savery's, we will observe the use of surface-condensation first; and subsequently that of a jet of water thrown into the midst of the steam to be condensed. * * *

The defects of the engine, as judged from a modern standpoint, were the great size and weight of the machine, relatively to its power; its still enormous consumption of steam and fuel; and its rude construction. It was still far from perfect in either design or construction, or satisfactory as to economical performance, even as finally built by Smeaton, the great engineer of that time who made its very best examples. The latter raised the best duty of the engine from about 10 per cent. to more nearly 12 per cent. of that of the better class of modern pumping-engines.

Smeaton made a number of test-trials of Newcomen engines to determine their "duty"—*i. e.*, to ascertain the expenditure of fuel required to raise a definite quantity of water to a stated height. He found an engine 10 inches in diameter of cylinder, and of 3 feet stroke, could do work equal to raising 2,919,017 pounds of water one foot high, with a bushel of coals weighing 84 pounds.

Thus, by the end of the third quarter of the eighteenth century, the steam engine had become generally introduced, and had been applied to nearly all of the purposes for which a single-acting engine could be used. The path which had been open by Worcester had been fairly laid out by Savery and his contemporaries, and the builders of the Newcomen engine, with such improvements as they had been able to effect, had followed it as far as they were able. * * *

James Watt and his engine now come into view. The success of the Newcomen engine naturally attracted the attention of mechanics, and of scientific men as well, to the possibility of making other applications of steam power. The greatest men of the time gave much attention to the subject, but until Watt began the work that has made him famous, nothing more was done than to improve the proportions and to slightly alter the details of the Newcomen and Cawley engine, even by such skillful engineers as Brindley and Smeaton.

This great man was born at Greenock, January 19, 1736. He was a bright boy, but exceedingly delicate in health, and quite unable to attend school regularly, or to apply himself closely to either study or play. At the age of 18 Watt was sent to Glasgow, there to reside with his mother's relatives, and to learn the trade of a mathematical-instrument maker. The mechanic with whom he was placed was incapable of giving much aid in the project, and Dr. Dick, of the University of Glasgow, with whom Watt became acquainted, advised him to go to London. Accordingly, he set out in June, 1755, for the metropolis, where, on his arrival, he arranged with Mr. John Morgan, in Cornhill, to work for a year at his chosen business, receiving as compensation 20 guineas. At the end of the year he was compelled by serious ill-health to return home. Having become restored to health, he went again to Glasgow, in 1756, with the intention of pursuing his calling there. Dr. Dick employed him to repair some apparatus which had been bequeathed to the college. He remained here until 1760, when he took a shop in the city, and in 1761 moved again into a shop on the north side of the Trongate, where he earned a scanty living, still keeping up his connection with the college. He spent much of his leisure time in making philosophical experiments. The introduction of the Newcomen engine in the neighborhood of Glasgow, and the presence of a model in the college collections, which model was placed in his hands in 1763 for repairs, led him to study the history of the steam engine, and to conduct for himself an experimental research into the properties of steam, using a set of improvised apparatus.

The Newcomen model, as it happened, had a boiler, which, although made to a scale from engines in actual use, was quite incapable of furnishing steam enough to work the engine. It was about 9" in diameter, and the steam-cylinder was 2" in diameter, and of 6" stroke of piston. Watt at once noticed the defect referred to, and immediately sought, first the cause and then the remedy.

He soon concluded that the sources of loss of heat in the Newcomen engine—which loss would be greatly exaggerated in a small model—were: first, the dissipation of heat by the cylinder itself, which was of brass, and was both a good conductor and a good radiator; secondly, the loss of heat consequent upon the necessity of cooling down the cylinder at every stroke in producing the vacuum; and, finally, a loss of power was due to the existence of vapor beneath the piston, the presence of which vapor was a consequence of the imperfect method of condensation which characterizes the Newcomen engine.

He first made a cylinder of non-conducting material—wood soaked in oil and then baked—and found a decided advantage in the economy of steam thus secured. He then conducted a series of experiments upon the temperature and pressure of steam at such points in the scale as he could readily reach, and, constructing a curve with his results, the abscissas representing temperatures, and the pressures being represented by the ordinates, he ran the curve backward until he had obtained approximate measures of temperatures less than 212°, and of pressures less than atmospheric. He thus discovered that, with the amount of injection water used in the Newcomen engine, bringing the temperature of the interior, as he found, down to from 140° to 175° Fahr., a very considerable back pressure would be met with.

Continuing his research still further, he measured the amount of steam used at each stroke; and, comparing it with the quantity that would just fill the cylinder, he found that at least three-fourths were wasted. The quantity of cold water necessary to produce condensation of a given weight of steam was next determined, and he found that one pound of steam contained enough heat to raise about six pounds of cold water, as used for condensation, from the temperature of 52° Fahr. to the boiling point; and, going still further, he found that he was compelled to use, at each stroke of the Newcomen engine, four times as much injection water as should suffice to condense a cylinder full of steam. Thus was confirmed his previous conclusion that three-fourths of the heat supplied to the engine was wasted.

His experiments having revealed to him the now well-known fact of the existence of latent heat, he went to his friend Dr. Black, of the University, with this intelligence; and the latter then informed him of the Theory of Latent Heat which had but a short time earlier been discovered by Dr. Black himself.

Watt had now, therefore, determined by his own researches, as he himself enumerates them, the following facts:

(1) The capacities for heat of iron, copper, and of some sorts of wood, as compared with water.

(2) The bulk of steam compared with that of water.

(3) The quantity of water evaporated in a certain boiler by a pound of coal.

(4) The elasticities of steam, at various temperatures greater than that of boiling water, and an approximation to the law which it follows at other temperatures.

(5) How much water, in the form of steam, was required, at every stroke, by a small Newcomen engine, with a wooden cylinder 6" in diameter and 12" stroke?

(6) The quantity of cold water required at every stroke, to condense the steam in that cylinder, so as to give it a working power of about seven pounds on the square inch.

After these well-devised and truly scientific investigations, Watt was enabled to enter upon his work of improving the steam engine with an intelligent understanding of its existing defects, and with a knowledge of their cause. It was on a Sunday afternoon, in the Spring of 1765, that he devised his first and his greatest invention—the separate condenser. His object in using it was, as he says himself, *to keep the cylinder as hot as the steam that entered it.* He was therefore the first to apprehend and to state a problem which the modern engineer is still vainly endeavoring completely to solve.

Watt was, at this time, twenty-nine years of age. Having taken this first step and made such a radical improvement, the success of the invention was no sooner determined than others followed in rapid succession as consequences of the exigencies arising from the first radical change in the old Newcomen engine. But in the working out of the forms and proportions of details in the new engines even Watt's powerful mind, with its stores of happily-combined scientific and practical information, was occupied for years.

In attaching the separate condenser, he first tried surface condensation; but this not succeeding well, he substituted the jet. Some provision became at once necessary for preventing the filling of the condenser with water.

Watt at first intended adopting the same expedient which worked satisfactorily with the less effective condensation of Newcomen's engine, *i. e.*, leading a pipe from the condenser to a depth greater than the height of the column of water which could be counterbalanced by the pressure of the atmosphere; but he subsequently employed the air pump, which relieves the condenser, not only of the water, but of the air which also usually collects in considerable volume, and vitiates the vacuum.

He next substituted oil and tallow for the water previously used in lubrication of the piston and keeping it steam-tight, in order to avoid the cooling of the cylinder incident to the use of water. Still another cause of refrigeration of the cylinder, and consequent waste of power in its operation, was seen to be the entrance of the atmosphere, which came in at the top and followed the piston down the cylinder at each stroke. This the inventor concluded to prevent by covering the top of the cylinder, and allowing the piston rod to play through a "stuffing-box," which device had long been known to mechanics. He accordingly not only covered the top but surrounded the whole cylinder with an external casing or "steam-jacket," and allowed the steam from the boiler to pass around the steam cylinder and to press upon the upper surface of the piston, where its pressure was readily variable and therefore more manageable than that of the atmosphere. It also, besides keeping the cylinder hot, could do comparatively little harm should it leak by the piston, as it might be condensed and readily disposed of.

The single-acting engine of Watt was now fully developed from the "atmospheric engine" of Newcomen. As improved it is shown in Fig. 6, which represents the engine as patented in April, 1769. Watt's first engine was erected with the pecuniary aid of Dr. Roebuck, the lessor of a coal mine on the estate of the Duke of Hamilton, at Kinneil, near Borrowstounness. This engine, which was put up at the mine, had a steam cylinder 18" in diameter.

In the figure, the steam passes from the boiler through the pipe *d* and the valve *c* to the cylinder casing, or steam jacket, *Y Y*, and above the piston *b*, which it follows in its descent in the cylinder *a*, the valve *f* being at this time open to allow the exhaust to pass into the condenser *h*.

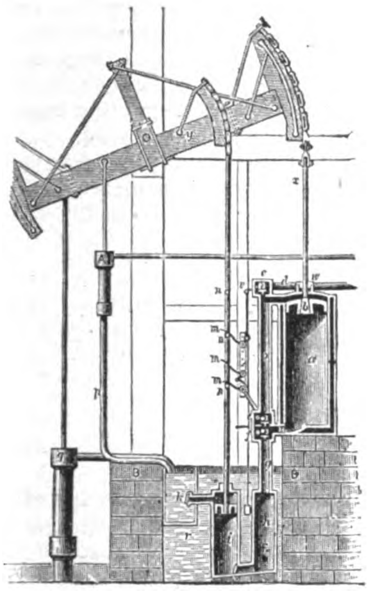


FIG. 6.—WATT'S PUMPING ENGINE A. D., 1769.

The piston now being at the lower end of the cylinder, and the pump rods at the opposite end of the beam *y* thus raised, and the pumps filled with water, the valves *c* and *f* close, while *e* opens, allowing the steam which remains above the piston to flow beneath it, until, the pressure becoming equal above and below by the weight of the pump, it is rapidly drawn to the top of the cylinder, while the steam is displaced above, passing to the underside of the piston.

Now the valve *e* is closed, and *c* and *f* are again opened, and the down stroke is repeated as before. The water and air entering the condenser are removed, at each stroke by the air pump *i*, which communicates with the condenser by the passage *s*. The pump *q* supplies condensing water, and the pump *A* takes away a part of the water of condensation, which is thrown by the air pump into the "hot-well" *k*, and with it supplies the boiler. The valves are moved by valve gear very similar to Beighton's, by the pins *m m* in the "plug-frame" or tappet-rod" *n n*.

The engine is mounted upon a substantial foundation, *B B*, *F* is an opening, out of which, before starting the engine, the air is driven from the cylinder and condenser.

Watt's double-acting engine was the next of his great inventions; and his scheme of the expansion of steam was quite as important.

Watt conceived the idea of economizing some of that power, the loss of which was so plainly indicated by the violent rush of the exhaust steam into the condenser, and described the advantages that would follow the use of steam expansively, by means of a "cut-off," in a letter to Dr. Small, of Birmingham, dated Glasgow, May, 1769. He also planned a "compound engine." This invention of the expansion of steam, which, in importance, was hardly exceeded by any other improvement of the steam engine, was adopted at Soho in 1776, but the patent was not obtained until 1782.

During this interval, Watt invented the crank and fly-wheel, but, as the former had been first patented by Wasborough, who is supposed to have obtained a knowledge of it from workmen employed by Watt, the latter patented several other methods of producing rotary motions, and temporarily adopted that known as the "sun-and-planet wheels," subsequently using the crank. The adaptation of the steam-engine to the production of rotary motion was soon succeeded by the introduction of the double-acting engine, the fly-ball governor, the counter, the steam-engine indicator, and other minor but valuable improvements, which were the final steps by which the Watt steam-engine became applicable to driving mills, to use on railroads, to steam-navigation, and to the countless purposes by which it has become, as it has already been denominated, the great material agent of civilization.

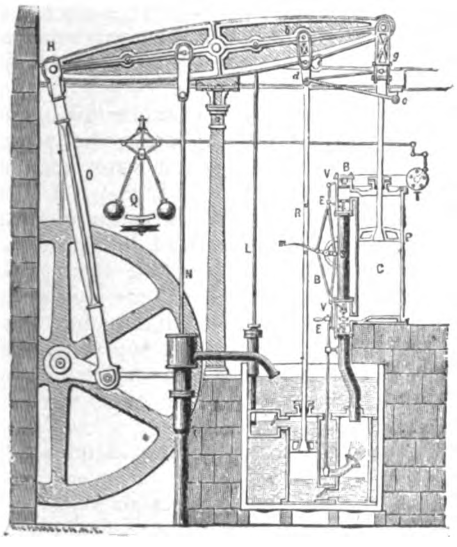


FIG. 7.—WATT'S ENGINE, A. D., 1780.

Fig. 7 represents the Watt double-acting engine. It will be noticed that it differs from the single-acting engine in having steam-valves, *B B*, and exhaust-valves, *E E*, at each end of the cylinder, thus enabling the steam to act on each side of the piston alternately, and practically doubling the power of the engine.

The end of the beam opposite to the cylinder is usually connected with a crank-shaft.

The later pumping engine of this type is shown in the succeeding figure, exhibiting the principal form of pumping-engine as now constructed.

Fig. 8 represents the Cornish pumping-engine, which, in spite of its great weight and high cost, is still in use.

It will be seen that it is the engine of James Watt in all its general features, with the addition, in its operation, of the application of Watt's idea of expansion of steam to something approximating the extent customary at the present time. It is single-acting, and has a steam-jacket and a plug-rod valve-gear, *J K*. The improvements are principally in the form and proportions of its parts, and in its adaptation to high steam and "short 'cut-off'." *A* is the steam-cylinder, *B C* the piston and rod, *D* the beam, and the pump-rod. The condenser is seen at *G*, and the air-pump at *H*. The steam cylinder is "steam jacketed," and is surrounded by a casing, *O*, composed of brickwork or other non-conducting material. Steam is first admitted above the piston, driving it rapidly downward and raising the pump rod. At an early point in the stroke the admission of steam is checked by the sudden closing of the induction-valve, and the stroke is completed under the action of expanding steam assisted by the inertia of the heavy parts already in motion. The necessary weight and inertia are afforded in many cases where the engine is applied to the pumping of deep mines, by the immensely long and heavy pump-rods. Where this weight is too great, it is counter-balanced; and where, as when used for the water supply of cities, too small, weights are added. When the stroke is completed, the "equilibrium-valve" is opened, and the steam passes from above to the space below the piston, and, an equilibrium of pressure being thus produced, the pump rods descend, forcing the water from the pumps and raising the steam piston.

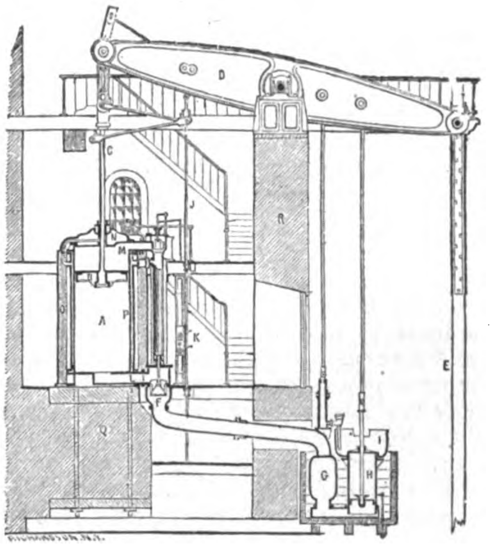


FIG. 8.—THE CORNISH PUMPING ENGINE, 1877.

The absence of the crank or other device which might determine absolutely the length of stroke compels a very careful adjustment of steam admission to the amount of load. Should the stroke be allowed to exceed the proper length, and should danger thus arise of the piston striking the cylinder heads, the movement is checked by buffer-beams. The regulation is effected by a "cataract," a kind of hydraulic governor, consisting of a plunger pump with a reservoir attached. The plunger is raised by the engine, and then automatically detached. It falls with greater or less rapidity, its velocity being determined by the size of the eduction orifice, which is adjustable by hand.

When the plunger reaches the bottom of the pump-barrel it disengages a catch, a weight is allowed to act upon the steam-valve, opening it, and the engine is caused to make a stroke. When the outlet of the cataract is nearly closed, the engine stands still a considerable time while the plunger is descending, and the strokes succeed each other at long intervals. When the opening is greater, the cataract acts more rapidly and the engine works faster. This has been regarded until recently as the most economical of pumping engines, and it is still generally used in Europe in freeing mines of water.—[From "A Manual of the Steam-Engine," Part 1st, by Prof. R. H. Thurston, Published by John Wiley & Sons, 53 E 10th street, N. Y.; 2nd part now ready.

(To be continued.)

FRENCH ingenuity has contrived a remedy for the inefficiency of ordinary combination locks for houses and apartments, these contrivances being usually of so little avail against professionals who, wasting no time in efforts to raise the tumblers and move the bolt, simply insert the end of a short iron lever, or "jimmy," between the door and its rabbit, forcing the whole affair inward, tearing out both locks and bolts on the way. According to the new device for meeting this difficulty a combination is resorted to of the iron shore with the ordinary lock in such a manner that locking the door sets a shore in place which will resist an enormous strain, but on the return of the proprietor the unlocking of the door in the usual way shifts the upper end of the shore from the door to the frame, where it presents no obstacle to the opening of the door. The mechanism of the lock itself need not be very elaborate, although the picking of the lock would move both the bolt and the shore, for if there are tumblers enough to prevent picking with a bit of wire, and if the "jimmy" is insufficient for the purpose, the point of security is attained.

AMONG the recent machine shop appliances brought forward, and described in the mechanical journals as of practical value, is a portable drill that may be driven by steam or compressed air, doing much of the work that its ordinarily accomplished by a ratchet. The drill is driven by a small rotary engine, to which the steam or compressed air is admitted through the pipes with valve attached; the shaft of the motor gears into the spindle of the drill, and an air or steam pressure of 45 pounds will operate the drill with results equal to those obtained with any fixed drill press. The machine is attached to the work just as in the use of an ordinary ratchet drill, and the feed is regulated by the screw at the top. The total weight of the drill is 42 pounds, and its capacity of execution ranges from a ⅝" to a 1½" hole in steel or wrought or cast iron. For bridge and structural work, ship-building, boiler-making and engine-building, these tools have proved very serviceable.

AN improved kind of soap for metal work has lately been described of some special advantages, it is said, as compared with those usually employed in this line—that is, mixtures of vaseline, oleic acid, and fat, combined with a small quantity of rouge—and which, when freshly prepared, leave nothing to be desired, excepting unfortunately, that such compositions soon turn rancid and become unfit for use. The new article now brought forward is stated to be free from this objection, and is made from cocoanut butter in the following manner: 2.5 kilos of the butter are melted in an iron vessel, together with a little water; to this mixture being added with constant stirring, 180 grms. of chalk, 87.5 grms. of alum and the same of cream of tartar and of white lead respectively. The mixture prepared in this manner is then poured into moulds and allowed to solidify. This soap is made into a paste with water and rubbed over the metal to be cleaned, and finally removed by a dry rag or chamois leather.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(307.) D. R——n, Leetonia, O., writes: "Would like to know if it would be an increase of power and a saving of fuel if one would turn the exhaust pipe into a running stream. The engine is a Buckeye 9"x18", and 200 revolutions per minute, and 70 pounds steam. The exhaust pipe is 10 feet long, then there is a feed water heater 6 feet long and then 10 feet to the creek." *A.*—This would be impractical and you would not gain any thing by doing it.

(308.) Frank W——x, Reese, Mich., writes: 1. "I have been having trouble with two boilers, one of the locomotive pattern, the other a common tubular, set in a brick arch. These boilers are a half mile apart, and both take water from a bored well 150 feet deep. The water is clear and tastes all right, and to all appearances is all right, but the tubes in both boilers are continually rusting, and they rust through in small spots, about the size of a common nail. We put in new tubes and they give out again in the same way, in about three or four months. Can you give any reason for this, and what can be done to stop it?" *A.*—If you will pump your water into a tank before using, and place some alkali in the tank (wood ashes or sal soda will do), this will be likely to stop the pitting of the tubes. 2. "I was down to Wheeler's shipyard, at Bay City, recently, and saw two large triple-compound engines being put into a large steamship. The valve and seat on the high-pressure cylinder was just roughed off with a dull pointed tool on the planer and was left in this condition. I was told there was not much pressure on this valve, and that the valve would wear to a seat of itself. I am positive that it was the cylinder that takes the steam first from the boilers. Will you please explain why this is left this way, and not smoothed down?" *A.*—Few shops scrape valve seats now, but leave them with the file marks in, as in this condition they lubricate better. But leaving them as they came from the planer is, we think, carrying this idea too far.

(309.) "Subscriber," Fort Worth, Tex., asks: 1. "Will you please inform me how to take the 'water meter,' that is, to read the amount the meter has registered? I have had a misunderstanding with a party in regard to the amount of water a meter has registered, and your decision will settle the matter." *A.*—The dials on a meter represent, 1 cubic foot, 10 cubic feet, 100 cubic feet, 1,000 cubic feet, etc. Some meters do not have dials for 1 cubic foot and 10 cubic feet, and some do not even have one for 100 cubic feet. To read a water meter, begin at the dial of the smallest denomination, and read around in the direction opposite the direction a hand moves on a watch, or to the left. Beginning with the units dial, or that for 1 cubic foot, write down the figure which the dial hand last passed over. If there is no units dial, write down a cipher. Now, to the left of this write down the figure which the hand on the tens dial last passed over, and if no tens dial, put down another cipher. To the left of this write down the figure which the hand on the hundreds dial last passed over, or if no such dial, a cipher as before, and so on until you have written down the figures on every dial. Now we have a meter before us to read. Supposing there is no units dial, we write down a cipher, the hand in the tens dial is between 6 and 7, so to the left of the cipher we place 6, giving us 60. The hundreds dial registers 4, which brings our figures to 460, and the thousands indicates 7, giving us 7,460. The hands on the higher denomination stand at the cipher, so we stop. There have passed through this meter 7,460 cubic feet of water. Some read meters the other way, beginning with the highest denomination, but it makes no difference. Either way will give the correct answer. 2. "Also tell me what the mixture is composed of that is used in place of matches. The mixture is kept corked in bottles, but it will ignite when exposed to the air. By giving me this information you will greatly oblige." *A.*—Phosphorus is probably the substance you refer to.

(310.) Albert Hull, Valley Forge, writes: "I will give you a little communication on an experiment I have tried to clean boilers. Probably the reader noticed in the *American Miller*, some time ago, the experience of an engineer cleaning boilers with kerosene. I have tried the same and can say it is the best way to remove scales I have ever tried. Can you tell me through the columns of the MACHINIST what causes check valves to squeal? I have one on feed pump that squeals on upward motion of plunger of pump." *A.*—The noise made by the check valve is caused by the minute vibrating movement of the valve against the seat or guard, and is caused by the rush of water. The movement is so rapid that it sometimes sounds like a squeal.

(311.) J. H., Cincinnati, O., writes: "Being a subscriber for your paper I would like to find out what is meant by slide valve gear. Have heard of the name, and as I am a gear cutter, should like to find out what its meaning is. I have received a book which, if I am to return, would like to find out. It is addressed to me, but then it says to return to your place." *A.*—The slide valve gear is that portion of the engine that works the valve and is not a gear or cog, as you appear to think, but the valve stem, eccentric, eccentric rods, etc. As we can not exactly make out the address, (the letter coming to us badly torn) we can not answer your question concerning the book except through the Q. and A. column. The printed notice "Return to Publishers SCIENTIFIC MACHINIST," on every book sent out, is for the guidance of the post office authorities, and only means for them to return it to us in case the party addressed cannot be found.

(312.) W. D. J. E——t, West Milton, O., writes: "We are having a great deal of trouble here, and I presume elsewhere also, with the coal oil that is sold at retail. Will you please give a method for testing it to find what standard we are getting? Answer through your 'Questions and Answers' column, and oblige a constant reader of your valuable paper. Give the simplest method known." *A.*—A method that is recommended by one who has used it is as follows: Place a cup of the oil to be tested in a basin of hot water. Put a cover on the cup, having a small hole in the top. Then place a thermometer tube in the oil. Set a lamp under the basin and heat the oil. The gas formed will escape through the hole in the top of the cover on the cup of oil. Now, take a match or a burning stick, and move it over the hole from which the gas is escaping. It will ignite and then go out, but after a time it will burn steadily, sending up a constant flame. When it burns steadily, look at the thermometer, and the degrees of Fahrenheit it indicates is the test of the oil. Thus, if it shows 175 degrees, the oil is 175 degrees fire test.

(313.) N. S——s., Jackson, Tenn., writes: "Can you refer me to a pattern maker in your city? I wish to get some engine patterns made." *A.*—The Gobeille Pattern Co., of this city, will probably furnish you any pattern you may want. It is a large and reliable pattern shop.

STEAM-PUMPS.

BY J. C. SMITH.

In presenting these articles to the reader, it will be the aim of the author to describe the different kinds of pumping machinery, and, at the same time, to give such information as may be of value to those who are employed in its construction or care.

It is a deplorable fact that there are many thoroughly competent mechanics who find themselves in a dilemma when called upon to overhaul an ordinary duplex pump. Nor is this ignorance confined to the workshop alone, but it can be found in the engine-room as well; and the writer has seen a pump sent back to the works, being pronounced out of order, when the real trouble was that some one, ignorant of its construction, had been meddling with it in order to make it work better and had failed.

There is no piece of machinery in such general use as a steam-pump; they can be found in all kinds of service, from the insignificant boiler feeder upon which some small plant depends to those ponderous engines, which like that wonderful and important muscle, the heart, that carries life and vitality to all parts of the human body, so they carry health and comfort to the thousands of inhabitants of a great city.

Before going into the details of the subject, it might be interesting as well as instructive to give a brief history of the origin and development of steam-pumping machinery.

The earliest authentic writings that we have of a liquid being lifted through the agency of steam is mentioned by Hero, a Greek philosopher, who lived about 200 B. C. In this apparatus the steam was allowed to act on the surface of a body of water in an enclosed vessel, the pressure of the steam thus forcing the water through a delivery tube, the lower end of which being below the surface. Of course, in this case, the temperature of the water must be equal to that of the steam, otherwise condensation would take place.

In 1606, Giavonni Porta invented an apparatus similar to that of Hero's but yet containing some improvements over the latter, the principal one of which was that the steam used for forcing the water was generated in a vessel separate from the one which contained the water to be elevated. This, it will be noticed, might be compared with the boiler of the present day, the steam performing its work in a separate machine.

Previous to the time of Thomas Savery, who followed Porta in his labors, about fifty years later, all attempts in raising water were confined to the experimental laboratory; but Savery brought his experiments into practical use, and his pumps were, to some extent, used in raising water from mines. His machine was superior to that of Porta's, inasmuch that he employed the vacuum in refilling the vessel in which the steam was generated.

Although a digression, it might be well to describe the vacuum in its application to the lift or suction of a pump.

The atmosphere extends to a height of about 45 miles above the surface of the earth, and having weight it presses down upon every square inch of the surface with a force equal to about 14.7 pounds, or fourteen pounds and eleven ounces; that is, if we could construct a tube, whose cross-section would be equal to one square inch in area, and whose length when standing vertically, the lower end resting on the ground, would reach to the limit of the atmosphere, we would find that the weight of this column of air would be about 14 pounds and 11 ounces, the weight in any particular locality varying somewhat according to the weather and elevation above the sea level.

Now, imagine an air-tight pipe of about 34 feet in height, and whose cross section is equal to an area of one square inch, with an ordinary hand pump attached to the upper end, while the lower end is just below the surface of a body of water.

Now it is self-evident that, as the piston of the pump is lifted, a portion of the air in the tube is withdrawn, and the pressure of the air therefore becomes less than that of the external air, which, being unable to get into the tube, forces a certain amount of water into it, until the pressure at the base of this column is equal to the pressure outside.

With another upstroke of the piston more air is withdrawn, and the pressure outside forces in more water, and by working the pump still further, we find a point above which the water will not rise, no matter how perfectly the pump may be constructed; now let us see how far that point is above the surface.

The tube is one square inch in cross section, and therefore each inch in height contains a cubic inch of water, and the pressure at the base of this column is equal to 14 pounds and 11 ounces, which is the pressure outside, for if it were greater or less, the water would flow out of or into the pipe, as the case might be.

Now, a cubic inch of water weighs nearly ⅗ of an ounce, and the total weight in the tube is equal to 14 pounds and 11 ounces, or 235 ounces; dividing this by ⅗ we have 392 cubic inches in the tube; but as each inch in height contains one cubic inch, it must stand at a height of 392 inches above the surface of the water, or at a height of 32 feet 8″ or about 33 feet, the extreme height to which a column of water can be raised by means of a vacuum.

In Savery's apparatus, the vacuum was produced, not by mechanical means but by the condensation of steam, which will be described later on.

It will now be noticed that the field of action in the development of the pumping engine has been transferred from Southern Europe to England, where it attained its highest development.

At about the year 1700, Newcomen, a machinist, in Cornwall, Eng., constructed a pump for the Cornish mines, and it appears that it was he who first used the cylinder and movable piston connected with the pump plunger, and although steam was the agent of its propulsion, yet it might be properly called an "atmospheric engine," the steam being used simply to produce a vacuum on the lower face of the piston.

Newcomen's engine consisted of a cylinder with a piston working vertically and attached to a walking beam at the other end of which was attached the pump rod, which was counter-balanced. When steam was admitted beneath the piston, it rose to the upper end of the cylinder, steam was then shut off, and a jet of water introduced to the cylinder, condensing the steam and producing a vacuum, the pressure of the air on the upper face then forced the piston to the lower end of the cylinder, where steam was again admitted, allowing the piston to rise again, the steam being again condensed by the introduction of water, and the piston again forced down. This reciprocating motion, transmitted to the pump plunger through the walking beam, forced the water from the mine.

But it remained for one giant intellect to bring the steam cylinder up to its present state of perfection—I say the present, for if the same shop appliances and workman skill of to-day existed at that time, the pumping engines of those days would have shown as high an economy, or as high a duty, as it is called in hydraulic science, as any of the best of the present time.

That man, whose name is as familiar to the student of steam engineering as that of Shakespeare is to the student of English literature, was James Watt. It was he who conceived the idea of a higher pressure of steam, studying its properties of sensible and latent heats; it was he who conceived the idea of cutting off the steam in the cylinder at an early point of the stroke, and thus obtaining economy in a high degree by its expansion; it was he who conceived the idea of the condensation of the exhaust steam in a separate vessel, thus keeping the walls of the steam cylinder from extreme changes in temperature, which was a most serious fault in the Newcomen engine; it was he who conceived the idea of the steam jacket, thus keeping the interior of the cylinder at an even temperature and superheating the expanding steam. A much improved valve gear was his also, and last, but not least by any means, that little instrument, the indicator, which in the hands of a skilled engineer shows those defects which would otherwise remain unknown, and which brought the pumping engines built by James Watt in the latter part of the 18th century in favorable comparison with the best of those of the present day—one hundred years later.

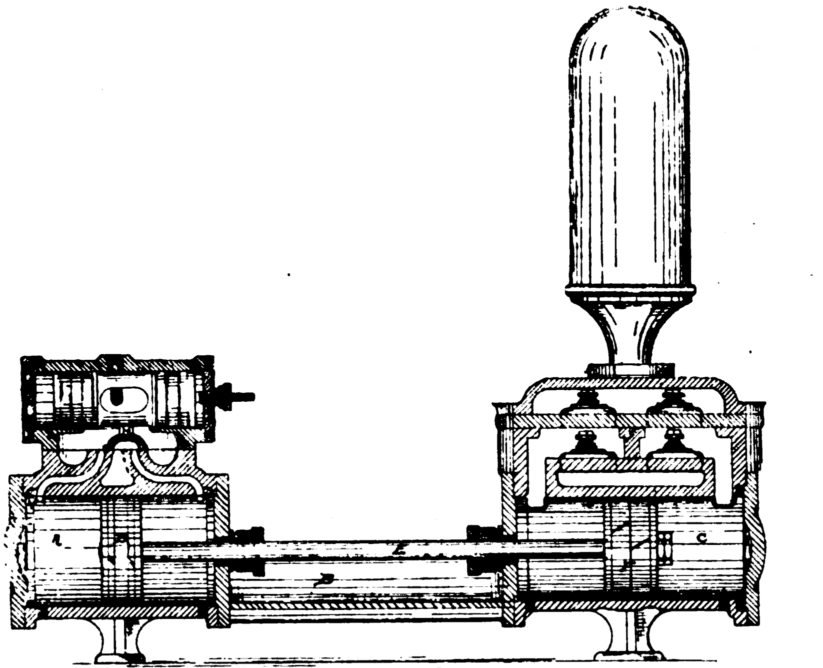
But the pumping engines of the present day, which are in general use, are different in design from those which have already been described. They are called "direct acting" machines, for the reason that the pressure on the steam piston is transmitted directly through the piston rod to the water piston or plunger, without the intervention of cranks, connecting rods or other designs of mechanism, and it is this class upon which we shall dwell mostly, although the author hopes to touch upon crank and fly-wheel pumps (high duty machinery) before closing the series.

Steam pumps are divided with regard to the number of steam cylinders with which they are fitted; those having but a single steam cylinder are called "single" pumps, while those having two steam cylinders, side by side, and each driving a plunger, are called "duplex" pumps; if they are fitted with another and larger cylinder, into which the high-pressure cylinder is allowed to exhaust, they are then called compound, single or duplex as the case may be. If the steam is further utilized by condensation, they are then called compound condensing, single or duplex pattern, distinguishing this class from the compound non-condensing single or duplex pattern, in which the exhaust is allowed to escape into the air.

They are again classified with regard to the water piston or plunger, the first being divided into ordinary packed piston and an adjustable piston, in which the packing can be set out against the barrel of the water cylinder as it becomes leaky from wear.

In the plunger pattern, a long barrel is substituted for the piston and contains no packing, although the barrel through which it works is sometimes converted into a stuffing-box. The plunger may be an inside packed, external or central externally packed, as the kind of work for which the pump is designed demands, all of which will be dwelt upon in their order. Again, the pump may be of the single-acting, double-acting or differential plunger pattern, all of which refer to the manner in which the discharge of the liquid takes place. In fact, the different kinds of service for which pumps are used make it a difficult matter to make a correct classification.

Since the direct-acting single pump is the most simply constructed, we shall begin by describing that style. The direct-acting single pump consists of a single steam cylinder A, a center piece B, connecting the steam cylinder with the water cylinder C, the accompanying cut showing a longitudinal section of the machine. Quite often, and in the smaller sizes especially, the center piece and steam and water cylinders are cast in one piece, thus saving the care of two joints in the use of the pump. It will be noticed that the pressure on the steam piston D is transmitted directly through the rod E to the water piston F. It will be seen that the steam ports *a a* are carried well back from the faces of the cylinder, the object of this is to cushion the piston (which is supposed to be moving in the direction of the arrow) after it has passed the port, thus preventing the piston from striking the heads of the cylinder, which difficulty would be overcome in a crank and fly-wheel engine, by proper adjustment of piston as the crank passes the center. In order that the steam may enter between the head and piston to force the piston back on its return stroke a small port *b b* is either drilled or cored in the casting, from the main port to the end of the cylinder, admitting sufficient steam to force the piston back until the main port is uncovered, when the piston receives the full benefit of the main steam port. The movement of the suction valves in the water cylinder in closing leaves but little work for the pump to do at the beginning of each stroke, so the auxiliary port *b b* is sufficiently large to supply the cylinder with steam at this point. The steam slide valve in this style of pump is generally moved by the pressure of the live steam in the steam chest, and its motion is governed by an auxiliary valve, which is driven by different styles of mechanism connected with or dependent upon the moving parts of the pump, each maker having some particular movement.



A description of the action of these motions will be given in the next article.

LITERARY NOTES.

The Engine Runner's Catechism. **Telling how to erect, adjust and run the principal steam engines in use in the United States, being a sequel to the author's work, "Steam Engine Catechism." Illustrated. By Robert Grimshow, M. E. Published by John Wiley & Sons, 53 E. 10 St., N. Y.**

This work is a compact volume, 6″ x 4½″, with 366 pages and nearly 200 engravings. The author is well known, and his work is always reliable.

The author's preface states more clearly than anything we could write the ground covered. He says:

"The remarkable and gratifying appreciation and success attending the publication of the author's original 'Steam Engine Catechism' (now in its tenth edition), and of its companion volumes, the 'Pump Catechism' and 'Boiler Catechism,' has led to the preparation of this book, which treats more of special builds of engines, as erected, adjusted, and run, than of the properties of steam, or the general principles of engine design and construction. It has seemed desirable to give descriptions of the general characteristic of various well known makes of engines; to follow these with details of shipping, making foundations, erecting, and starting, and then to give detailed instructions as to the adjustment of special makes, each of which has its own peculiarities of construction, often puzzling even to engineers of long and varied experience. This last feature, in particular, should prove specially valuable to young engineers, or to those in isolated plants, where opportunities for communicating with other engineers, or with the builders of an engine that may be unfamiliar, are few. The author has tried to make his instructions plain, complete, accurate, and up to date. Should it fail in any item, he would take it as a favor to be told of errors, or asked concerning omissions."

Machinery Pattern Making, **containing full size profiles of gear teeth and fine engravings on full-page plates, illustrating manner of constructing numerous and important patterns and core boxes, by P. S. Dingey, practical pattern maker and mechanical draftsman. 376 fine illustrations, 12mo, cloth, $2.00. Published by John Wiley & Sons, 53 E. Tenth street, N. Y.**

The above is a work of great value to pattern makers. The name of the author has become familiar to readers through the *American Machinist*. It is not intended as an elementary treatise, but is a discussion of methods. The author states that pattern making can never be taught through books, which will be concurred in by nearly all practical men. However, there is much that can be learned from the methods of others, as this volume amply proves. The book will be found very helpful in every pattern shop.

THE editor acknowledges with thanks the receipt of a package of pencils from the Joseph Dixon Crucible Co., of Jersey City, N. J. They are all that could be desired in any office. The Dixon pencils are the best in the market. This we do not say because we received the gift, but because it is an acknowledged fact.

Practical Letters.

Feeding the Boiler.

EDITOR SCIENTIFIC MACHINIST:

In answer to a writer in your paper asking engineers to express their opinion as to which is the best method of feeding a boiler, by pump or injector, will say: If you have a heater through which you force your water, a pump is by far the best and most economical, but if you have no heater, use an injector without regards to economy, as I would not put cold water into my boiler except through a spray feed at top of boiler.

I once took charge of a plant of 11 large boilers which were fed by an injector, and there were times when we had to shut off one of the boilers from the main line and run the steam up on that boiler to a high point to run the injector, in order to supply the others, and it would take all the steam the boiler would make. The best I could do was to put the water into the boilers at 142° Fahr., as there was no other way to put water into the boilers except through the pump-house, and cold water at that, although there was a large tank sunk in the ground right alongside of the pump-house where the drip from ten engines and fourteen sets of drying cans ran, and from there off into the river boiling hot, so it could not be lifted by the pumps in the pump-room. I made a large pit in one corner of my fire-room and placed one of my small pumps in there, down below the bottom of the tank, and made my connection. The pump was piped off with ¾" pipe, and with less than one turn of the valve we could supply the 11 boilers with water at boiling point, and I have tested it when I found it 215° Fahr. Now, the injector was piped with 2½" pipe, and we opened the valve wide open. Now, what was the saving in steam? I could not tell because I made other improvements at that time of equal importance, but I do know that I made a saving in my department alone of over 70 per cent. on our productions.

If I was fitting up a plant to-day, I would put in one of the best heaters I could find, without regards to cost, and use a pump, but I would put on an injector to use in case the pump gave out, and I would put in other improvements which I may speak of at another time. J. M. C.

Prick-Punching a Misfit, or How to Make a Misfit Fit.

EDITOR SCIENTIFIC MACHINIST:

Now, it may be that some who read this will think that the person who wishes to pawn off a misfit by prick-punching, is a sort of misfit mechanic. But, however, there may be times in course of a person's experience when it will come in handy. It may, in fact, point out the way for him to work out of a tight place.

For instance, on one occasion I was working on an engine that had to be ready for the foundation on a certain day. It was for a large firm, and they had canceled contracts after a certain date, and at that time they were going to begin to tear down walls and get ready to set up the new engine. The contract specified a large forfeiture for every day after this date that the engine builders delayed setting up the engine. We had already used up the allotted time trying the new valve gear, and at the last moment a man made a misfit in fitting in the crank pin, making it too small for the disk. Say! there was some swearing around, but this did not help the matter any and after a little consultation the foreman suggested that he prick-punch the pin, thinking that he might be able to make it last until we got the engine going, and intending when the loose pin showed up, to make a new one for it and lay the blame of the misfit to a man that had been discharged. In so doing they would get the engine up without any more delay.

Under his instructions we put the misfit pin in the lathe and spaced it off in equal spaces by simply scratching around the pin at the proper distance apart. Then we laid it off equally the other way (lengthwise), drawing lines end-ways at equal distances apart around the pin. Then by putting in prick-punch marks at the intersection of each line we had it ready to place on the disk.

Well, we got the engine set up in time and we made a new pin, expecting to have to put it in before the engine run very long, but we never put it in. That was over ten years ago, and for more than five years past this engine has been overloaded, and the pin is yet intact, as solid now as any pin I know of.

This incident had nearly escaped my mind when, about five years later, an instance happened that impressed it more forcibly upon my mind, and I probably will not forget it for years to come. I was on a steamboat. It was in a big blow on Lake Superior, on the 25th day of November. The wind was blowing a gale from the Northwest, I should judge in the neighborhood of forty miles per hour. On the day previous I noticed a pound in the crank, but did not pay much attention to it, thinking that this would not hurt her any, and that we could key up when we got over the lake. But the wind kept blowing harder and harder, and the seas breaking over us, and we began to roll and tumble in a way that takes the glory out of engineering. We had a large, heavy schooner in tow, and her strain made our timbers crack and groan, as our stern settled down and raised out of the big seas. It is at these times that a young man begins to realize that there are some things in engineering that he did not carve in his imagination when aspiring to be a knight of the throttle.

Now, I observed that the crank pin was pounding more and more, and as the pound increased so rapidly, I began to suspect that something was getting loose. Thinking it might be the key working out, or something else of that nature, also taking into consideration that there was no shelter around and the seas were increasing every minute, I concluded that if we were going to do anything with the engine that now would be the best time, as it might be too late if anything should happen to us; for in that sea I was certain that Saint Peter would never save us. So, after consulting the captain on the subject, we shut her down for a minute to fasten the key, as this was what I supposed it was. Upon a hurried examination, I found to my dismay that the crank-pin was very loose, with every indication that it would get considerably looser, but as we were already tumbling around, nearly standing on our beam ends, there was nothing else left to do but start her up and keep her going in hope that we could reach some shelter before anything let go. We kept this up all night.

We thought that every stroke would be the last, and we expected to see the engine let go any moment. We knew that it could not stand very much longer and that it was only a question of an hour or so until we would be at the mercies of one of those northwesters on Lake Superior. If the reader has been in one, he will acknowledge that they are not exactly an opera matinee.

The captain said he would try and make the land at seven, which had at daylight shown up about twelve or fourteen miles off. After an hour or two we ran almost in the trough of the sea, nearly all the way. We finally got into comparatively smooth water. Nearly all the way in I was scheming on some way of temporarily repairing this difficulty in the pin. It was pretty late in the Fall and we wanted to get down to the lower lakes before it froze up. There was no way to do therefore, but to fix it ourselves so that it would last until we got into some port. Now, this was when the prick-punch scheme dawned on my mind and twenty minutes later we had the engine disconnected. We did not have any trouble in getting the pin out of the disk, as it would almost have fallen out, and in thirty minutes more it was off. I then carefully laid it out and prick-punched it in the way before described. In three hours and twenty minutes we had the engine connected and ready to start. The wind shifted around to the northeast, and we had to get out of our place of shelter pretty quickly. Well, we made our trip and we did not have the least particle of trouble with the pin, though we had a hard pull of it in a snow storm, and for all I know the same pin is in yet. I have never heard of it being taken out or giving any more trouble. H. F. COOK.

HE STUCK IN THE BOILER.

The boiler from which the steam heat is supplied to the Colonnade Hotel, Broadway, near Lafayette place, says a New York daily paper, needed cleaning out. Friday morning Daniel Donlin, the engineer, crawled into it, as he had often done before, through the manhole in the dome on top of the boiler. In entering the boiler his feet became firmly wedged between the flues which run horizontally through the big steel shell, and he found himself caught as in a gigantic vise. He was unable to get further in or to crawl out, and had to call for help.

Help came in time and Donlin was rescued, but as the boiler had to be taken apart to accomplish it, his rescue is as interesting as his predicament.

Donlin, who is 28 years old, is short and heavily built. As many as could caught hold of his arms and tried to pull him out, but could not budge him an inch. Donlin was so cramped by this time that he was suffering great agony.

Somebody went outside and called in Policeman Gannon, of the Mercer street squad. Mr. Gannon is a strong man, but he couldn't make Mr. Donlin "move on" or move out. So Officer Gannon went out and called an ambulance. Why he did not call the fire department is a mystery. Perhaps he thought the ambulance surgeon would amputate the visible part of Donlin's body and thus save the boiler, or else amputate the boiler and save Donlin intact. But after all, sending for the ambulance proved to be a good thing, for the engineer was gradually sinking under the terrible strain of his position.

Meanwhile, the hotel people had telephoned for ex-Judge Henry Hilton, who is said to own the building. Mr. Hilton came just as the ambulance surgeon, Charles Weeks, began to administer stimulants to the imprisoned engineer, who was almost in a state of collapse. When Mr. Hilton came he saw that heroic measures were necessary, and he sent post haste for a force of boilermakers to come down from a shop in West Thirty-fourth street. The boiler men were on the scene half an hour later, each one carrying sledges, chisels and other tools. The great heat of the engine room and the excitement caused Donlin to almost faint several times, but he was revived with brandy.

The boiler men saw at once that the dome of the boiler would have to be removed. Rivet after rivet was cut away in quick succession, and finally the dome was lifted off. Everybody was in despair when it was found that the wedging was in the boiler, not in the dome. The engineer's knees were under the steel frame around the opening from the dome to the boiler, and to extricate him an entire plate of the boiler must come off. At the rivets again went the boiler men, and they gave way to the sturdy strokes of the sledges on the cold-chisels. After two hours of work the plate was removed and Donlin was taken out, too weak to stand. He was removed to St. Vincent's Hospital in the ambulance, to be treated for prostration. Judge Hilton directed the operations of the boiler men until Donlin was released, when he went on down-town to his office.

Donlin was able to return to his home Friday night, and was on duty yesterday, as usual. The boiler, meanwhile, had been repaired and was furnishing heat as before.

IT appears that in Scotland there is a company which pays a certain amount yearly to a number of iron works for the privilege of collecting the smoke and gases from the blast furnaces. These are passed through several miles of wrought iron tubing, and as the gases cool, there is deposited a considerable yield of oil; one plant is reported to yield twenty-five thousand gallons of furnace oil per week. The sum paid for this privilege is such as to be profitable, it is said, to both parties. The oil thus obtained is distilled, and a considerable quantity of cresol, phenol, and some other substances are procured from it, while the oil remaining is used as an enricher of gas for illuminating purposes.

Ironmaking in Brazil.

A bulletin recently issued by the Bureau of American Republics states that the State of Minas Geraes, in Brazil, abounds with iron ore. It is not found in veins or strata, buried deep in the earth, but in enormous beds, often lying at the surface, or in mountain masses. These vast deposits are worked only by small scattered furnaces, charcoal being used in the reduction of the ore. Of these small furnaces there are five groups, producing about 3 000 tons annually, the product being used in the surrounding districts in the manufacture of articles of home consumption, such as hoes, shovels, picks, drills, nails, horseshoes, etc. In the State of Sao Paulo are found deposits similar to the best Norwegian ore, and one of the mines is worked by the government establishment, near the village of Sorocaba. This establishment has two furnaces, and produced in 1887 790 tons of pig iron. The ore has about 67 per cent. of iron. In Santa Catharina, not far from a harbor which is accessible to the largest vessels, are vast deposits of hematite, containing 30 per cent. of manganese and 25 to 30 per cent. of iron.

1892.—MECHANICAL SCIENCE FOR ALL.—1893.

Below is given an outline of the contents of the "Scientific Machinist" for 1892. These papers are not merely contemplated, but will positively be published. We can mention only about one-half of what is coming at this date. Most of these will begin at once and all soon. Nearly all will be finely illustrated. Any subscriber can have any subject within our scope treated by simply making the request. Our staff of special writers will give what is wanted.

Steam-Engine Building and Repairing. These will be by able men and will cover the ground thoroughly.

Steam-Boilers. This series comes from a writer recognized as authority throughout the country. No one should miss his papers.

Steam-Pumps. These are being prepared by one engaged in building all kinds of pumps. Their use and how to keep them in condition will be made plain in a practical way.

Erecting Steam Plants. A well known and popular author will, in this series, give valuable instructions for setting up plants of all kinds.

Shop Practice, Kinks and Methods. Several different writers will furnish papers in this line. There are too many to mention specifically in this brief outline.

New and Easy Ways of Doing Work. This has reference to the Machine Shop, and more than one will contribute to it.

Pattern-Making. The papers under this head will be found very useful to every pattern maker.

The Anvil and Forge. A practical blacksmith will write on his craft under this head.

Foundry Work. We are only able to say about these that they will be first class.

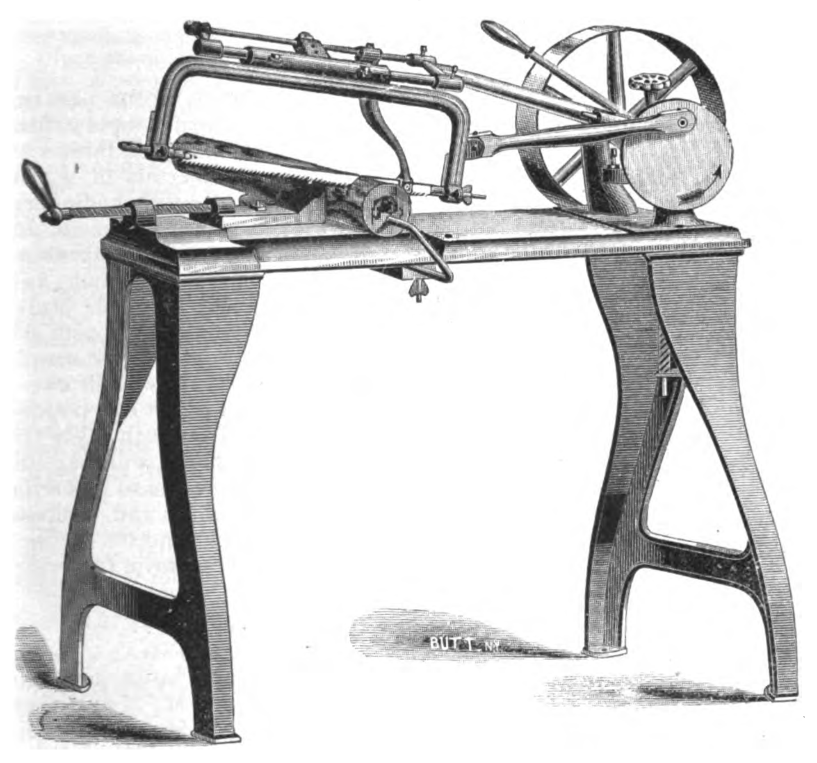
Practical Electricity. The "Electrical Lessons," now in the ninth number, will be continued under this head, and when finished will be published in pamphlet form. Every yearly subscriber beginning after this date will get a copy free. A special writer will, outside of the lessons, treat every phase of electrical practice as applied in engine room and shop.

Questions and Answers, Practical Letters, New Tools and Devices, Scientific-Mechanical Special Articles, Miscellaneous Notes and Papers and illustrations of the finest quality will be found in every issue. We can not begin to give every detail of what is coming. Are you paying money for mechanical information? if so, do not leave us out. Please note our ExtraInducement on page 3. Kindly show this to your friends and associates, and get them to subscribe.

Don't wait. Subscribe now. **Pub. "SCIENTIFIC MACHINIST."**

THE STAR POWER SAW.

This machine is designed for cutting iron and steel. It will cut any size up to 4½ inches in diameter, and any shape that can be held in the vise. It also cuts piping very nicely. The makers do not claim great speed in cutting, but metal can be cut much more rapidly in this machine than can be done in a lathe or planer, or by heating and cutting with a "blacksmith's hack," and at a trivial cost. By its use a good percentage of metal is saved, as the pieces cut are left smooth and no labor or metal is lost in squaring up, as is the case after heating and cutting with the "hack." This saving in Hobson's, Jessop's or other high cost steels is quite an item in stock, to say nothing of labor. For cutting up die blocks and a thousand and one other things, the advantage of using this saw will be manifest. The blades used for cutting are the Star hack saws, 10, 11 and 12 inches in length. The only expense is the comparatively slight wear of these blades, and the little time taken in securing the stock to be cut in the vise to the machine and setting the latter in motion. No attention is required until the piece is cut off. The expense of blades is small, as one blade will cut off a steel shaft 4½ inches in diameter several times. The machine should be run from 45 to 50 revolutions per minute. It is certainly a valuable labor saving tool for the blacksmith shop, the tool or machine room, as it can be put to many uses not at once suggested to the mind. Manufactured by Millers Falls Co; factory, Millers Falls, Franklin Co., Mass.; warerooms, 93 Reade street, New York.



News Notes.

D. H. McCarthy contemplates removing his model and machine factory from Kansas City, Mo., to Milwaukee, Wis., providing a suitable location can be secured. The principal work of the shop is to make models of a fine construction.

The Wright Machine Co., at Worcester, Mass., are building an additional machine shop 100x42 feet in size.

About $14,000 worth of new machinery is to be placed in the Sun Foundry & Machine Shops, at Provo, Utah.

Brightman & Collins, Cleveland, will erect a machine shop, to be 58x103 feet, two stories, and built of brick.

It is reported that the Steam Heater Co., of Susquehanna, Pa., will erect a new and larger machine shop next season.

Plans have been prepared for a foundry for O. Rourke & Co., of Peoria, Ill., to be 40x120 feet, built of brick and frame.

Two additions, 100x30 and 100x40, respectively, will be built to the works of the Jenkins Machine Co., at Sheboygan, Wis.

The Lufkin Rule Co. will remove from Cleveland, O., to Saginaw, Mich., January 5th, 1892, where they will occupy new and commodious shops.

The Sucker State Drill Co., of Belleville, Ill., will double their capacity.

The Haugh-Ketcham Co. is building a new $8,000 foundry, at Indianapolis, Ind.

The Flenniken Turbine Co., of Dubuque, Ia., propose to enlarge their plant.

Arrangements have been made with the Phœnix Lock Co., of Newark, N. J., for the removal to Martinsburg, W. Va., of the builders' hardware factory.

To the Reader: If not a subscriber you should subscribe for this paper. It contains more matter of merit for the price than any other mechanical journal. See our REMARKABLE offer on page 8, which holds good only a short time. Don't fail to take advantage of the best bargain you will ever strike.

Leading in Iron Ships.

According to an advance synopsis of the report of William W. Bates, commissioner of navigation, the documented tonnage on the Northern lakes June 30, 1891, was 1,154 870 tons. The entire documented tonnage of the country is 4 648 759 tons, represented by 23 889 vessels. Iron vessels measuring 57,989 tons were built on the lakes during the year. This is more than half of the iron vessels built in the entire country. Atlantic coast shipyards built 46 265 tons of iron, and there was built in all parts of the country 105 618 tons.

The following table shows the tonnage, apportioned in respect to the several grand divisions of the country:

	1888.		1889.		1890.		1891.	
Grand Divisions.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Atlantic and Gulf coasts...	604	83,168 43	657	93,912.24	663	156,755.99	944	218,392.46
Pacific coast......	104	21,956.43	112	17,939 43	93	12,334.92	122	19,069.84
Northern lakes......	222	101,102.87	225	107,080.30	191	108,525.87	204	111,856.45
Western rivers......	84	11,859.15	83	12,202.36	104	16,505 98	114	19,983 54
Total.	1,014	218,086.88	1,088	231,134.33	1.051	294,122.76	1,384	369,302.29

The documented iron tonnage on the lakes is 181,724 tons, and on the seacoast 554 963 tons. The entire documented iron tonnage, including that of the Western rivers, is 741,598.24 tons. The documented tonnage on the Northern lakes June 30, 1891, was 1,154,870 tons; on the Western rivers, 308 345 tons; on the Pacific coast 440,858 tons, and on the Atlantic and Gulf coasts, 2,780,683 tons.—[Marine Review.

Another Ship Canal.

Hon. W. C. Gear, of Wyandot, who will be a member of the next Ohio State Senate, gives the outline of a bill, which he will introduce early in the session, providing for the construction of a canal to connect the Ohio with the lakes. Senator Gear's proposition is to divert the course of the Ohio Canal into the Muskingum, recently improved by the Government, at Dresden, which would permit Lake Erie boats to enter the Ohio river at Marietta while he would divert the course of the Miami and Erie into Mill creek at Cincinnati. Senator Gear, who is a civil engineer, estimates the cost of the Miami and Erie improvment would be about $18,000,000, while that of the Ohio canal would amount to $10,000,000.

Sharpening Tools by Electricity.

An electro-chemical method of sharpening files and other tools, is being used with satisfactory results, both from a practical and economical point of view. The files, which have first been thoroughly cleaned, are immersed for 20 minutes, suspended in a metal plate in a mixture of 100 parts of water, six parts of nitric acid and three parts sulphuric acid. The plate is placed in connection with a number of carbons immersed in the same liquid. The corrosion of the metal takes place in the cavities only, so that the edges are sharpened in exactly the same manner as if the operation had been performed by a file cutter.

HINTS TO ENGINEERS.—VI.

BY EDWIN WOODWARD.

After a boiler has been put in good running order, trimmings all refitted, joints packed, and everything right and filled, and ready for the fire to be applied, it is the duty of him who has it in charge to see that everything remains so, save the natural wear incident to its use. It should be the first duty before the fires are started to try the water. It is not sufficient to know that enough was had when it was left, the evening before, perhaps. Much water is often lost through evaporation, if but a minute escape of steam is had. The check-valve may let it flow back into the well, if but a very small substance, gravel, sand, or anything with strength sufficient to keep it from seating come between, and it is well to have a drip-cock placed in such a place as will empty the pipe to prevent its freezing and also serve as a tell-tale if the check-valve should leak.

The boiler should have a globe valve placed between it and the check, as communication with the boiler can thus be shut off, and the latter examined in case anything befalls it, and be repaired or renewed if necessary without loss of steam or water. It has ever been the custom of the writer in putting in globe valves, to place them in the way that would bring the pressure under the valve instead of on the top of them, for many reasons, regularity of supply being an important one, for pressure coming against brings no risk of closing and shutting off supply; while coming the other way a sudden jar often moves the disc, the slack there is in it thus increasing the supply, which, if well throttled, may equal or even exceed 100 per cent.

But the globe valve between the check and the boiler is one important exception to this rule. It should be placed so the boiler pressure comes upon its top, from the pump beneath its face. The jar resultant from each stroke and the seating of the valve has a tendency to gradually close the valve, if packed easy, also to rattle the disc from its collar on the stem, and where either occurs—quite frequent on some engines—it is simply a matter of a new pump or some part of it, especially if its motion be positive. When a pump stops from the valve-disc coming off, if no harm is done to the pump or its fittings, it necessitates the cooling of the boiler, for no water can be fed it till the passage is clear, which can only be accomplished without steam pressure.

The blow-off cock frequently is leaking when supposed to be closed, and disastrous accidents are often traced to this. The piping of the blow-off is equally as dangerous as piping the overflow of an injector, either of which will forfeit insurance in a careful company.

It is not prudent to trust to the glass water gauge to indicate the amount of water in the boiler unless its water passages are known to be free at that instant. If the lower passage be filled, condensation may fill the glass two or three inches above the water level, and if the upper be filled, the confined air in the tube will prevent water from showing, when the boiler in reality contains an ample amount. When the water shows at the gauge cock, it may be assumed that there is sufficient. When every opening is perfectly tight, there is in the boiler after cooling a vacuum, which will deceive the novice if not careful. When the cock is opened air will gurgle in, but no water will come out. Lift the safety valve to correct the equilibrium. Repeat this operation every morning, as a factor of safety.

The "Pop" safety valve is used far in excess of any other style at the present, preferably so from the fact that they will fulfill the requirements in any position,—the rattle and jar of service on the railroad, the swaying and tumbling of the road and traction engine, have no disturbing influence over them, a spring doing duty in place of the lever and weight.

However, the latter form is not by any means obsolete. They are most excellent for stationary plants, and are easily kept in order. As there seems to be no disposition among proprietors to throw them aside while they will do their legitimate work, there should, correspondingly, be no disposition among enterprising learners to shun the theoretical or mathematical mysteries that seemingly surround them.

Many of the so-called rules claiming "government inspection" origin, are not only not from this source, but are also inaccurate, and when coupled with a defective steam gauge are really dangerous, if the engineer attempts to regulate the weight of the pee or length of lever for a given pressure by such. The subject is easily comprehended, and an attempt will be made to make it clear.

In the first place, the area of the valve must be found—square the diameter and multiply by .7854, and the product is the area of the valve in square inches. This multiplied by the pressure to be carried, will give the total weight that must be applied to hold the steam in place, if it is applied direct as is used on low pressures, but in high pressures it is accomplished by means of a lever and smaller weight, which brings in anotherpart of the problem, and before proceeding it is necessary to know the weight of the valve and lever.

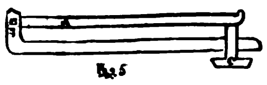


Fig 5

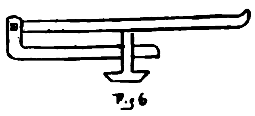


Fig 6

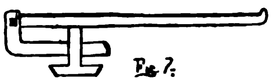


Fig 7

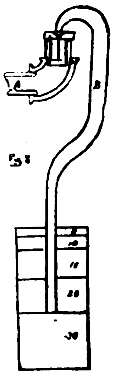


Fig 8

A contributor to a technical ournal which came under the writer's notice not long since, in explaining this matter, after multiplying area of the valve in inches by the number of pounds of steam pressure, instructed the learner to deduct the weight of valve and half the weight of lever from this product. This latter part of his instructions will require something "weighty" to substantiate them. Figs. 5, 6 and 7 will give a clear idea of it. For convenience consider lever A a bar of ½"x1¼" flat iron, 24" long, weighing four pounds. If placed as Fig. 5 the bolt B would sustain half its weight, the other half would tend to hold valve C down, and, consequently, half the weight of the lever would be available in this position, but it is not used so. If the lugs to which the lever is fastened be less extended, and the valve placed in the middle of its length, the lever will balance and all its weight will be utilized. If placed as Fig. 7 half way between the middle and end its effective weight is doubled, and an available force of eight pounds is achieved from a lever weighing but four pounds, which may be still further increased by moving its fulcrum nearer the end, the value of the increase being inversely with the ratios of the lever. As the length of lever from the center to valve is to the length of lever from the valve is to the bolt, the total weight of the lever being the other factor, it is evident that not only the weight of the valve, but also the effective weight of the lever as explained, must be deducted. The required weight should bear the same ratio to this remainder that the fulcrum does to the length of the lever. For example: If the area of a valve is 5", its weight 2 pounds, lever 24", fulcrum 4", weight 4 pounds, steam pressure 80 pounds. Required, the weight. Pressure, 80 × 5 = 400 pounds; valve 2 pounds, available weight of lever 12, = 14 pounds, leaves 386 lbs. Then:

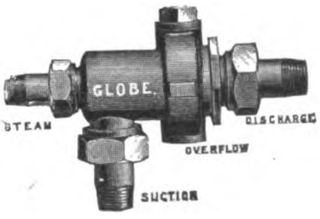
(fulcrum)		(lever)		(weight required)		
4	:	24	:	: (66⅓)	:	386

If every part of the valve is in a trusty condition—the lever not rusted fast to its bolt, nor binding in its guide—the valve stem being clean and the guide wings of valve not scaled or rough, then it may be depended upon to keep the pressure to safety limits. But let any of these evils befall it, and the steam gauge becomes rusty or gummed in its working parts, then neither the gauge nor safety valve indicates as much pressure as there is. Discover then which is wrong. Do not condemn the steam gauge because a leak from the safety valve leads to the idea that the valve is raising from pressure which does not correspondingly effect the gauge, and it is also not logical to blame the valve when the steam gauge from long use or abuse, becomes weakened and inaccurate. Test the gauge with one known to be accurate. This is generally inconvenient, and often impossible, and a device like Fig. 8 is cheap and reliable, and should be a part of every engineer's outfit. Pipe A (broken off) should connect with the boiler and be stopped with a globe valve. The nipple entering the upper part of the elbow should be of brass and bored out at the seat to exactly 1⅛" in diameter, when its area will be practically one square inch (.994+). The valve guide wings should be a free sliding fit, its top counter-sunk that hook B may have no tendency to shift from its place. Weights, as indicated, may be employed, or in the absence of them, a bag of sand or any convenient weight may be used. To be still more accurate, valve and B may also be weighed.

The steam gauge should indicate pounds of steam for pounds of weight attached to the test gauge, when the latter raises enough to let the steam escape.

GLOBE AUTOMATIC INJECTOR.

Great as have been the improvements in steam goods in the past ten years, probably no one article has come to the front with such rapid strides as the injector. The cumbersome, three and four handled cool-me-off injectors of a few years ago were not popular with engineers. But the injector of to-day, the Automatic injector, without handles, no stuffing boxes, no cooling off, that is simple in construction, and easy to operate, is a deservedly popular boiler feeder. In offering the Globe injector to the trade, we guarantee that it is the most simple in construction, the most reliable and easiest to operate. It will lift every time with a hot suction pipe; it will work under, from 25 to 130 pounds pressure; all tubes can easily be taken out and cleaned and can easily be duplicated by simply sending number of injector to factory, will be sent out on trial to responsible parties. A trial will convince you of its merits and superiority over others. For price list and testimonials and terms to dealers send to C. F. McCombs, 37 So. Water street, Cleveland, O. Notice the advertisement on the last page. Agents will do well to write for terms.



CRESCENT COMPRESSION GREASE CUP.

The accompany cut represents the latest design of the well-known grease cup of the Crescent Manufacturing Co., of Cleveland, O. This cup feeds positively and automatically, and can be so set without being touched, or as fast or slow as desired, and so that any portion may be fed, say one-half, or one quarter. Semi-solid lubricants or greases of any nature or consistency may be placed at top, side or bottom of bearing.

It is adapted particularly for use on locomotives, marine, fire, stationary, portable and gas engines, motors, dynamos, blowers, loose pulleys and mill machinery. Write for particulars to the Crescent Manufacturing Co., 97 River street, Cleveland, O., and mention the SCIENTIFIC MACHINIST.

A WOMAN MACHINIST.

[Concluded.]

No woman ever worked more faithfully to save from ruin her means of livelihood than did Matilda Blount, during the three months which the note run, and it may also be said, that no woman ever had a more diligent and interested assistant than she had in foreman Larry Neil. They had toiled early and late and managed every way possible to raise money. But it came in slowly. Many who had brought back their work were disposed to consider their renewed patronage a favor for which Miss Blount should be content to wait their convenience for the pay. Others were dependent upon the slow operation of business dealing, in that town so slow by nature, and their creditors were obliged to abide their time till some farmer found it convenient to drive in, or other contingencies.

Two days before the last day of grace, there was a long-faced pair in the Blount office. They had $1,000 in the bank, but where the other $500 was to come from they could not see. Matilda had called on the various firms and institutions which loaned money, but could make no arrangment to get even a small sum with which to lift the mortgage. The security was ample, for Peter Pinch did not put out $1,500 where there was any risk. But no one would relieve her. It was gently hinted, by a merchant that, the usurer had, in his wily way, "fixed" things so that she could not get a cent from any of the lenders of money. This was confirmed by a circumstance that transpired on the day above mentioned. After a gloomy consultation, Larry started out to try his wits at collecting. He called on a builder, for whom a good deal of work on architectural iron had been done, and who had promised to settle by a certain time, but had not done so. When Larry entered the builder's office he overheard a conversation between that gentleman and Peter Pinch, in an outer room. The usurer was urging the builder to buy a piece of land, which he stated could be had in three or four days at a very low price. The builder was ready to take it, provided he had the means, but as he had promised Miss Blount a certain sum he would be obliged to pay it and let the opportunity pass. It is not necessary to give an abstract of the conversation, but Larry heard enough to convince him beyond a doubt that Pinch was endeavoring to prevent the payment of that honest bill to Miss Blount, till it would be too late to help her out of her dilemma.

The Irish-American blood of the young man was brought to a boiling point by the old man's intrigue, and he made some mental vows that would not have contributed to Peter's peace, had he known of them.

He succeeded in getting $150 from the builder and $50 from other sources, but yet they were short $300, nor could they get more, for the lemon had been thoroughly squeezed.

On the night before the day of the expected Waterloo, Larry walked home with Matilda, as he had done quite frequently within a few weeks previous. The tarry at the gate was unusually protracted. Just what transpired the writer can only arrive at by the natural deductions; but certain it was that Larry's spirits were much more buoyant than they had been for several days.

It was ten o'clock before he finished his supper. Instead of looking over the evening paper a few moments and then slipping off to bed, as was his wont, he donned his thick overcoat and sallied forth to the livery stable, and, procuring a riding horse, left the town and reined into the west turnpike, on a brisk gallop.

Matilda was not a little troubled, next morning, to find her foreman absent. She did not know where he had gone, and could procure no information from the men in the shop. Nine, ten, eleven o'clock came, and yet he did not come. She then sent word to his boarding house, only to learn that he had gone away the evening before without leaving word concerning his movements. This troubled the girl not a little, for while it was certain to her that the shop must go, it would have been some comfort to have her faithful helper there to the last.

The crisis had arrived, however, and it was too much for her. About 12 o'clock she buried her face between her arms on the desk and wept bitterly. It was a bitter hour indeed. She heard the whistle blow, and then the door creaked on its hinges. Although she did not look up, she knew that Peter Pinch stood there, and that she must walk out of her dear father's old shop, never again to say she had a right even to a nail in the door.

Pinch advanced until he saw Matilda prostrated with adversity, and then his face began to screw up in the most outlandish manner. It meant that he was satisfied that a victory was scored. He raised his voice to speak, but Matilda, too much overcome to endure the ordeal of a conversation, waived him back with one hand and said, without raising her head: "Take the shop, but say nothing."

Old Peter was fairly beside himself with joy. He rushed out into the shop and into the boiler room in the rear, and seizing the rope that communicated with the whistle, blew such blasts that the whole town was alarmed. He was turning to leave when a strong hand laid hold of his collar, and a voice said: "What are you doing in here?"

"Doing as I please with my own property," answered Peter Pinch, squirming to get away. "Well, you get right out there," said the voice, as such violent locomotion was applied to him that he found himself, a second later, in the ditch at the foot of the bank, which fell off from the engine-room door.

Matilda did not notice the horse that stopped in the yard, breathless from exhaustion, and did not hear the door again open, but she did feel an arm placed around her, as one she knew said: "No more tears, Matilda. The money is at the bank to meet the note at 12:30. I rode 50 miles to get it."

Just then the whistle began to blow, and Larry Neil stalked through the shop to see what was the matter, and then followed what has been already described.

There was occasion soon to again change the sign on the shop, for Matilda was fully occupied in her pleasant home, made happy by her mother and devoted husband.

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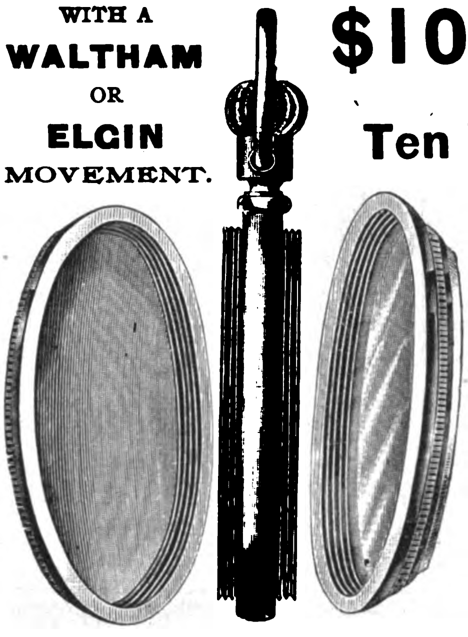

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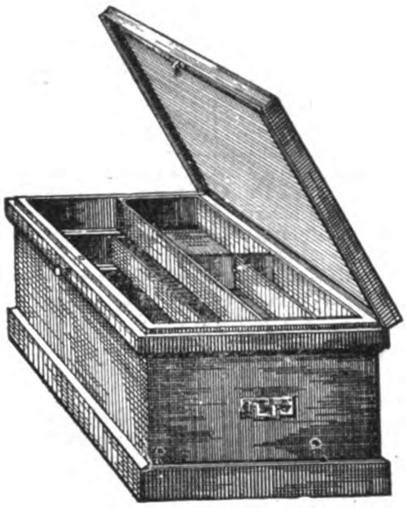

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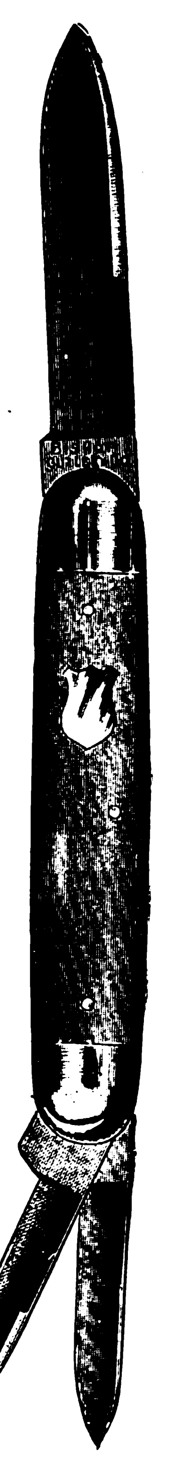

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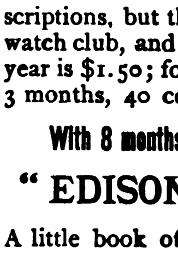
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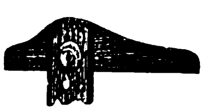
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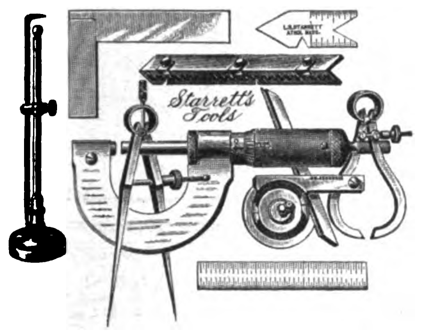

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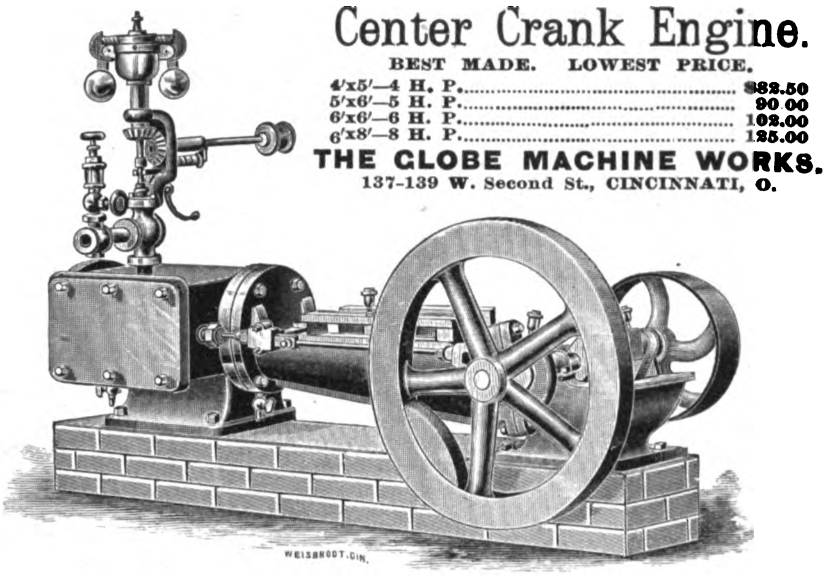
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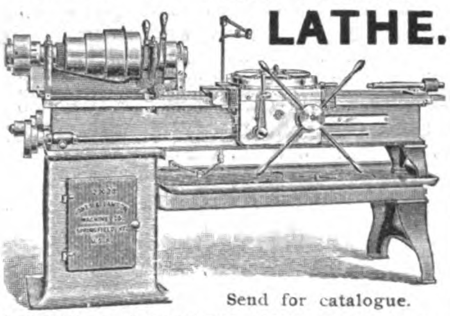

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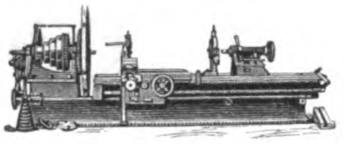

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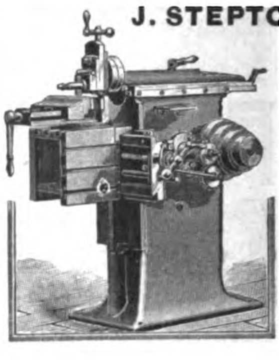

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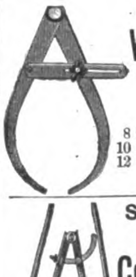

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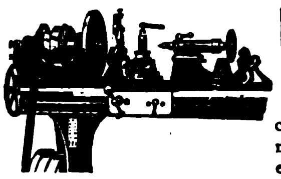

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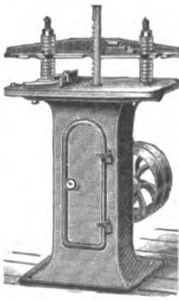

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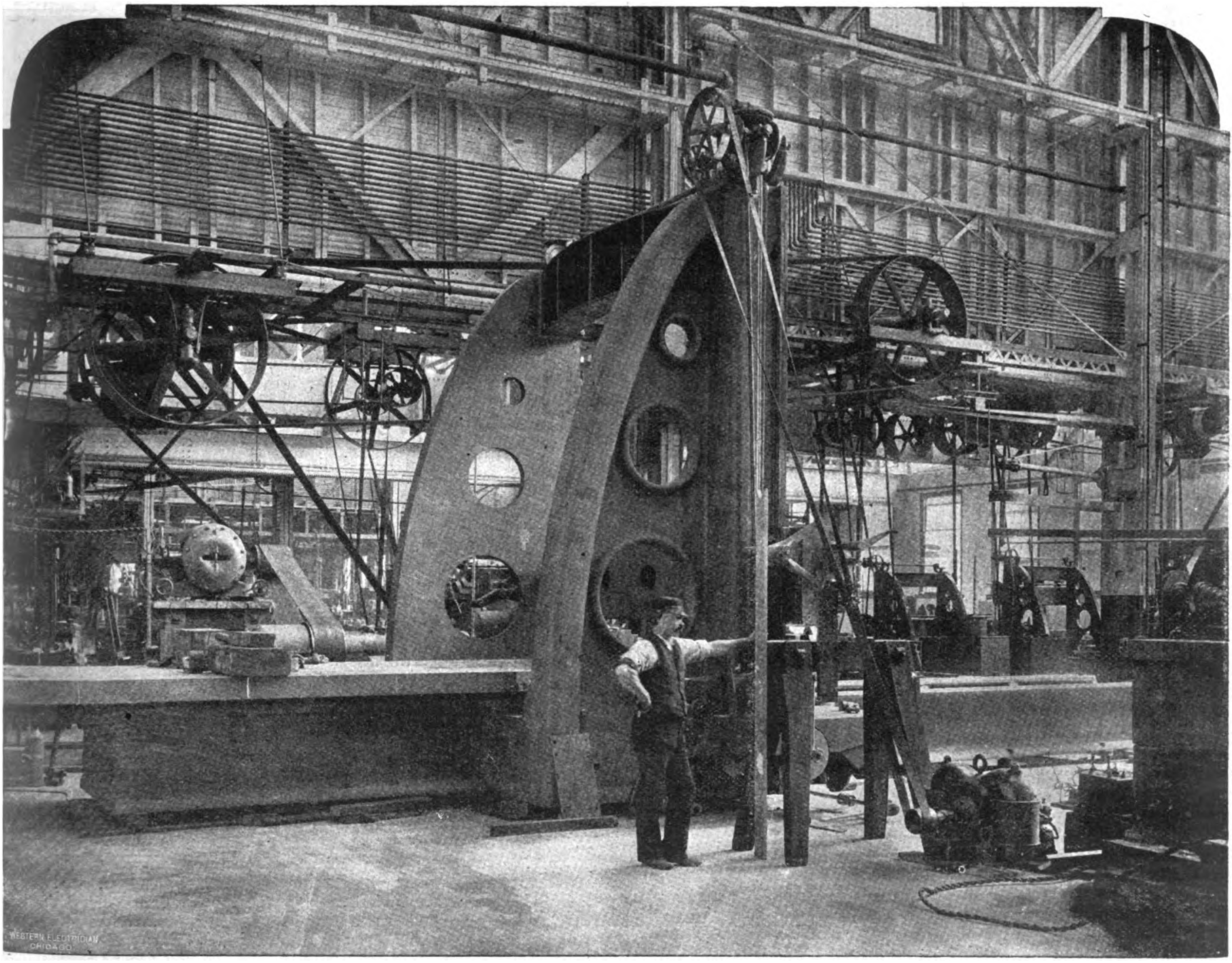
USE OF ELECTRIC MOTORS IN BUILDING AND MOVING HEAVY MACHINERY.

The peculiar adaptability of the electric motor under circumstances where it is impracticable to resort to steam or other well-known sources of power, is now very generally appreciated by mechanical engineers. In the illustration is shown an immense planer which had been ordered by the Edison company for its factory, and is being built by Coleman Sellers, of Philadelphia. This huge machine, at the time the photograph was taken, was very nearly completed. Several machinists were engaged in putting on the finishing touches, and by the aid of the electric motors, these men were enabled to fit and adjust the parts to the greatest nicety without moving the machine from its first position in the erecting shop. The parts were fitted in one by one, and when, for instance, to get a bearing it was necessary to put any particular piece in motion, an electric motor was resorted to for power. The motors in such a case as this are of course mounted on only rough stands—in fact, they are set up with no regard to looks, and in any manner that they will run satisfactorily and aid the workmen. About the William Sellers & Co. factory there may be found at present five electric motors which are employed in miscellaneous work. The great cranes in the Sellers' works, with which the reader is already familiar, are driven by the motors, taking current from the same circuit as the other motors. We are indebted to the *Western Electrician* for the accompanying cut, and this information.



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THE DEVELOPMENT OF THE STEAM-ENGINE—IV.

BY PROF. R. H. THURSTON.

Hornblower's Engine.

The compound engine originated in Watt's time. Fig. 9 represents the first "compound" or "two-cylinder" engine. This class of engines, in which the steam exhausted from one cylinder is further expanded in the second, was first introduced by Hornblower, in 1781, and was patented, in combination with the Watt condenser, by Woolf, at a later date (1804), with a view to adopting high steam and considerable expansion. The Woolf engine was to some extent adopted, but was not successful in competing with Watt engines where the latter were well built, and, like Hornblower's engine, was soon given up.

The compound engine has come up again within a few years, and with what is *now* considered high steam and considerable expansion, and designed with more intelligent reference to the requirements of economy of working steam in this manner, it is gradually displacing other forms of engine.

The engine patented by Hornblower in 1781 was first described by the inventor in the "Encyclopædia Britannica." It consists, as is seen by reference to the engraving, of two steam-cylinders, *A* and *B*—*A* being the low and *B* the high-pressure cylinder—the steam leaving the latter being exhausted into the former, and, after doing its work there, passing into the condenser, as already described. The piston-rods, *C* and *D*, are both connected to the same part of the beam by chains, as in the other early engines. These rods pass through stuffing boxes in the cylinder heads, which are fitted up like those seen on the Watt engine. Steam is lead to the engine through the pipe, *G Y*, and cocks, *a*, *b*, *c* and *d*. are adjustable, as required to lead steam into and from the cylinders, and are moved by the plug-rod *W*, which actuates handles not shown. *K* is the exhaust pipe leading to the condenser. *V* is the engine feed pump, and *X* the pump-rod carrying the pump buckets at the bottom of the shaft.

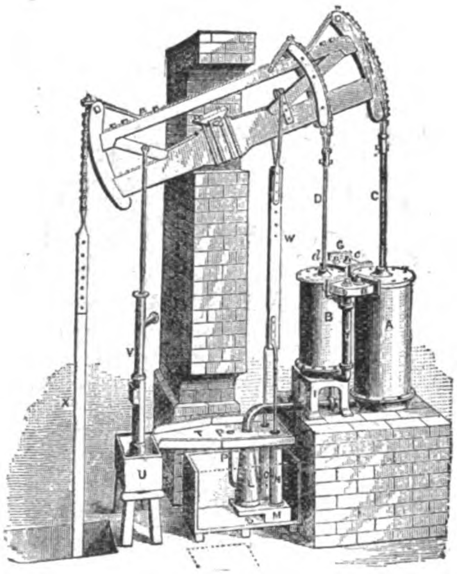

FIG. 9.—HORNBLOWER'S COMPOUND ENGINE, 1781.

The cocks *c* and *a* being open and *b* and *d* shut, the steam passes from the boiler into the upper part of the steam cylinder, *B*; and the communication between the lower part of *B* and the top of *A* is also open. Before starting, steam being shut off from the engine, the great weight of the pump-rod, *X*, causes that end of the beam to preponderate, the pistons standing, as shown, at the top of their respective steam cylinders.

The engine being freed from all air by opening all the valves and permitting the steam to drive it through the engine and out of the condenser through the "snifting valves," *O*, the valves *b* and *d* are closed, and the cock in the exhaust-pipe opened.

The steam beneath the piston of the large cylinder is immediately condensed, and the pressure on the upper side of that piston causes it to descend, carrying that end of the beam with it, and raising the opposite end with the pump-rods and their attachments. At the same time, the steam from the lower end of the small high-pressure cylinder being let into the upper end of the larger cylinder, the completion of the stroke finds a cylinder full of steam transferred from the one to the other with corresponding increase of volume and decrease of pressure. While expanding and diminishing in pressure as it passes from the smaller into the larger cylinder, this charge of steam gradually resists less and less the pressure of the steam from the boiler on the upper side of the piston of the small cylinder, B, and the net result is the movement of the engine by pressures exerted on the upper sides of both pistons and against pressures of less intensity on the under sides of both. The pressures in the lower part of the small cylinder, in the upper part of the large cylinder, and in the communicating passage, are evidently all equal at any given time. When the pistons have reached the bottoms of their respective cylinders, the valves at the top of the small cylinder, B, and at the bottom of the large cylinder, A, are closed, and the valves *c* and *d* are opened. Steam from the boiler now enters beneath the piston of the small cylinder; the steam in the larger cylinder is exhausted into the condenser, and the steam already in the small cylinder passes over into the large cylinder, following up the piston as it rises.

Thus, at each stroke a small cylinder full of steam is taken from the boiler, and the same weight, occupying the volume of the larger cylinder, is exhausted into the condenser from the latter cylinder.

Referring to the method of operation of this engine, Prof. Robison demonstrated that the effect produced was the same as in Watt's single cylinder engine—a fact which is comprehended in the law enunciated many years later by Rankine, that, "so far as the theoretical action of the steam on the piston is concerned, it is immaterial whether the expansion takes place in one cylinder, or in two or more cylinders." It was found, in practice, that the Hornblower engine was no more economical than the Watt engine; and that erected at the Tin Croft Mine, Cornwall, in 1792, did even less work with the same fuel than the Watt engines.

The plan unsuccessfully introduced by Hornblower was subsequently modified and adopted by others among the contemporaries of Watt; and, with higher steam and the use of the Watt condenser, the "compound" gradually became a standard type of steam-engine.

Arthur Woolf, in 1804, re-introduced the Hornblower or Falck engine, with its two steam-cylinders, using steam of higher tension. His first engine was built for a brewery in London, and a considerable number were subsequently made. Woolf expanded his steam from six to nine times, and the pumping-engines built from his plans were said to have raised about 40,000,000 pounds one foot high per bushel of coals, when the Watt engine was raising but little more than 30,000,000. In one case a duty of 57,000,000 was claimed.

* * *

The progress of steam-pumping engine efficiency, from the time of Newcomen and of Watt to date, is seen in the following figures:

Date.	Engine.	Duty; ft.-lbs. per 100 lbs.
1769	Newcomen (by Smeaton)	7,000,000
1772	" " "	12 000 000
1776	Watt	21 600 000
1778	Watt, expansive	26,600,000
830	Cornish	86 585 000
1880	Compound	100,000,000
1885	"	110,000 000
1890	"	120,000,000

The duties given are those either guaranteed or actually resulting from trials. The fuel demanded per horse-power per hour thus has decreased from about 35 pounds in Smeaton's Newcomen engines, and 8 in Watt's best work, to 2¼ pounds in the Cornish, and to less than 1.25 in later engines of the compound type; the minimum given being 1.5. Even this figure has been reduced with later engines of the three and four-cylinder type.—[From "A Manual of the Steam-Engine," Part 1st, by Prof. R. H. Thurston, Published by John Wiley & Sons, 53 E. 10th street, New York; 2d part now ready.

[To be continued.]

Stephenite.

A new aluminum flux called stephenite, from the name of the inventor, is receiving considerable attention at Birmingham, England. It is composed of alumina and emery, the alumina being about 70 per cent. In its natural state this flux is not volatilizable like the refined commercial aluminum, but in a blast cupola or reverberatory furnace it gives off its metallic gases or vapors, these uniting with the fusible iron, for which they have great affinity, and which acts as a condensing agent, while all impurities go to the liquid slag, and are drawn off in the usual manner. It is found that metal manufactured by means of this flux will work equally well under the hammer with the most malleable wrought iron, and will harden up to the hardest steel. It also appears that the metal will work over and over again, becoming hard or soft as the operator may desire, tests having likewise proved that, in its soft state, it will stand a tensile strain of about 38 tons on the square inch, and, when hardened, of about 48 tons. Another point upon which stress is laid is that the use of such a flux causes the iron to flow in a much more liquid state and to remain in that condition a considerable time longer than by the ordinary process, thus preventing blow-holes and faulty castings, which is, of course, a great desideratum. It is regarded as a great advantage that, by this means, iron founders are enabled to produce their own steel castings, independent of steel works, by simply smelting scrap steel in their own crucibles.

Silvering Iron.

In silvering iron a recent process introduced in Austrian workshops consists in plunging the iron article into hot dilute hydrochloric acid, whence it is removed to a solution of mercury nitrate and connected with the zinc pole of a Bunsen element, gas carbon or platinum serving as the other pole. It is rapidly covered with a layer of quicksilver, when it is removed, washed and transferred to a silver bath and silvered. By heating to 300° Cent., the mercury is driven off, and the silver firmly fixed on the iron. To save silver the wire may be first covered with a layer of tin, one part of cream of tartar being dissolved in eight parts of boiling water, and one or more tin anodes joined with the carbon pole of a Bunsen element. The zinc pole communicates with a well-cleaned piece of copper, and the battery made to act until enough tin has deposited on the copper, when this is taken out, and the ironware put in its place. The wire thus treated is is much cheaper than any other silvered metals.

A New Fast Time Steamer.

The model of the new steamer building at Glasgow will, it is claimed, insure the quickest possible transit of the Atlantic Ocean attainable by steam craft. With a length of 630 feet, and 70 feet beam, very fine lines are obtained, and the twin screws are of some 23 feet diameter, well supported. There are four funnels, and about 200 feet of the length of the ship is devoted to the boilers and bunkers. The engines, triple compound, with four cylinders working four cranks, are figured at 33,000 horse-power. Accommodation is provided for some 700 first and 300 second-class passengers and about 400 emigrants, and all arrangements worked out in the plans for carrying out this important feature are far ahead, it is claimed, of anything yet produced in nautical construction. The plating of the ship is carried up to the promenade deck, which runs from end to end, and about 20 feet on each side is left for walking.

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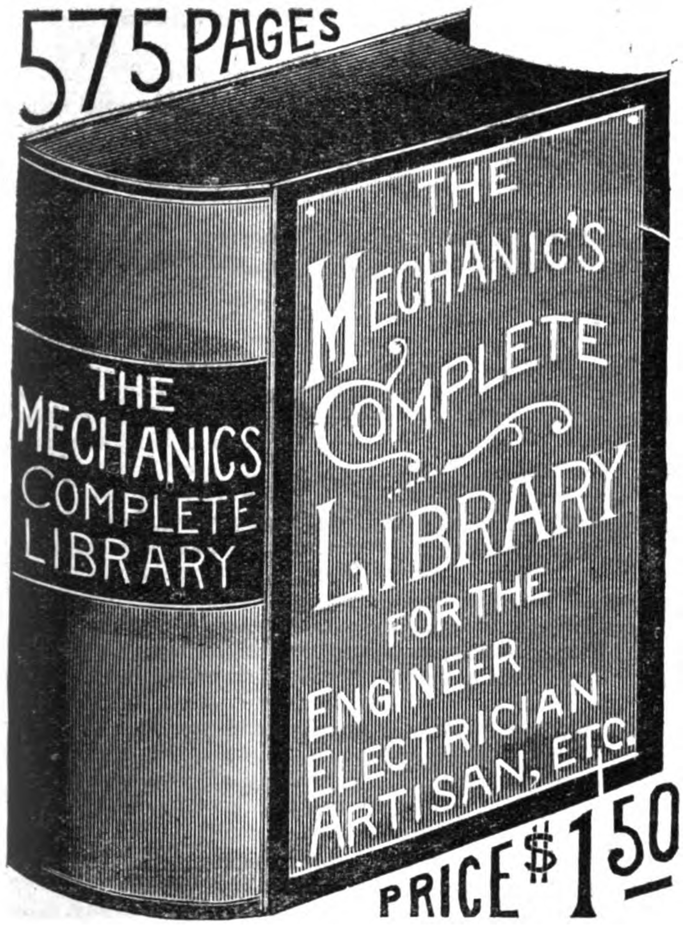
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A word about our paper seems in order right here. THE SCIENTIFIC MACHINIST is published on the 1st and 15th of every month, and is $1.50 per year, in advance. We consider it the cheapest mechanical journal published, judged either by the amount or quality of reading matter. The work of the best mechanical writers will be presented in every issue. What more can any journal give its readers? Examine it and form your own opinion.

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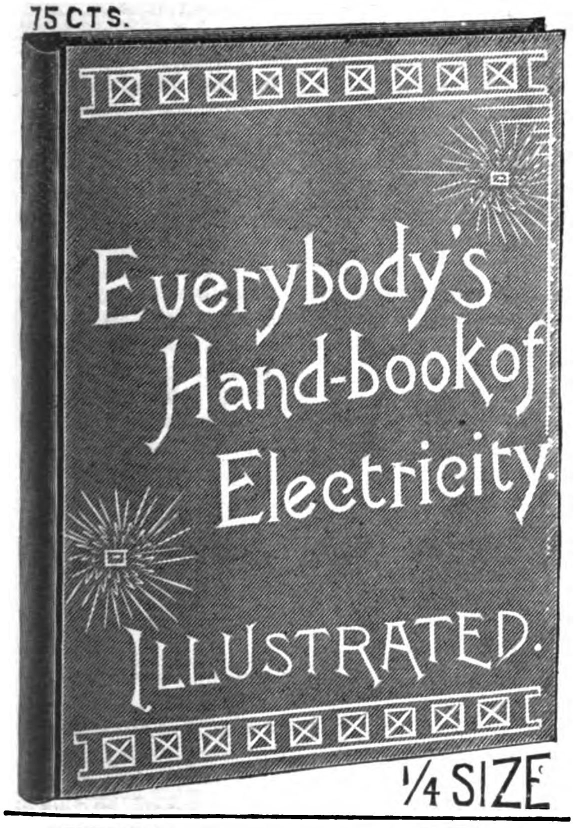
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SEE PARTIAL LIST OF CONTENTS ON PAGE 14.

DYNAMOS AND MOTORS and EVERYBODY'S HAND-BOOK OF ELECTRICITY Are by Edward Trevert, a well known and reliable author. They have been given many flattering notices by the press and are splendid volumes. The cheapest editions, in cloth, were never sold for less than 50cts. a copy. The editions we have bought are **extra fine paper and binding, worth 75 cts. each, and cannot be bought for 50 cts.**

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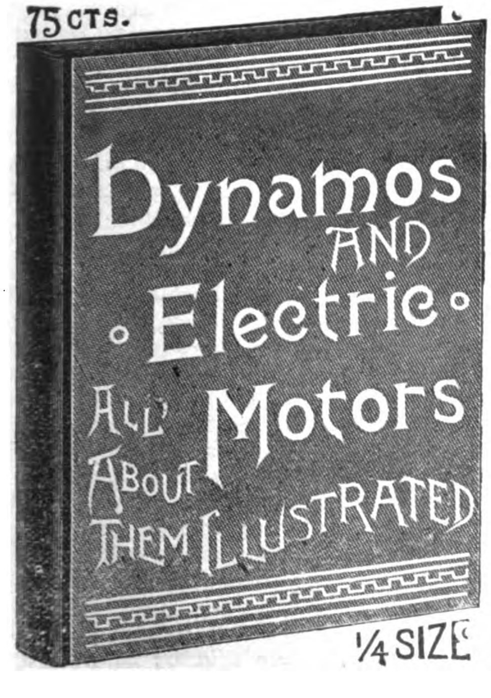

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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience or experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, FEBRUARY 1, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

THE FINANCIAL REWARDS OF MECHANICS.

We so often hear it said that "smart" men no longer adopt mechanical professions or pursuits, that we fear many young men may be misled, and many older ones disappointed with their choice of occupation. It is true that many of our "smart" men will not, nor will they adopt any calling imposing any considerable toil upon them. They want to get along by their wits, not their muscle. Surely, well meaning boys should not be guided by the action of such chaps. There are others who are not lazy nor careless how they make money, but who are over fastidious and consider old clothes, grease, dirt, and honest, manual toil degrading, even though it requires much brain work also. They may be nice fellows, but they seldom amount to much and very, very often come at last to that alleged degradation so carefully shunned in their youth. It is not to be expected that such men will ever enter a shop.

Those who talk most about the men of ability steering clear of mechanics, think that all of the ability comes from the upper-middle, as generally known, and aristocratic classes. The proportion of such people who now take up mechanical work is greater than it ever was, but the pessimists do not consider that the poor, from which class the shops are recruited largely, furnish more brains and genius than the comparatively well-to-do classes.

Drones and easy-going men will not progress in any walk of life, and there are many mechanics as well as men of other callings who get along poorly. But, on the other hand, there are many professional men, clerks, accountants, etc., who would be far better off if they were skilled workmen in some mechanical capacity. There are instances without number of mechanics rising from a humble position in the shop to great power, influence and wealth, by using their brains and applying themselves to the work in hand. How many have exempted themselves from daily toil by inventions, and by starting in business for themselves, in a small way? Thousands, in every State.

There are whole wards in Cleveland owned principally by mechanics, who bought their homes, furnished them comfortably, many elegantly, and sent their children to school, often to college, on their wages. They are in better shape, with better prospects of ease in the future, than the majority of small merchants and salaried store and office help. There are, in fact, few men so independent as a first-class machinist, sober, reliable and industrious, who owns his home, has some money in bank and a business-like administration of household affairs. How many doctors, lawyers and other men who, when they were turning the corner of boyhood, would call him a "poor fool" for learning a trade instead of going to some "'varsity" and getting crammed for a profession, would now be glad to swap positions with this man? You can find them in every block, in every square, in a city or town.

The one who has in him the metal to succeed on the line of his natural adaptability and preference, will find, if his ability lies in the mechanical direction, that there is a broader and infinitely better opportunity for emolument in the machine shop now than at any previous period.

HOW TO MAKE A DIE FOR THE PUNCH PRESS.

SERIES OF "SHOP PRACTICE, KINKS AND METHODS."

At the present age of advanced progress in mechanics, it would seem an almost fruitless task to write upon any particular topic relating to trades or tradesmen in any branch. Able writers of scientific and practical knowledge have "covered the whole field," leaving nothing more to comment upon, or methods to explain, and, but for a few reasons, we would seem to have reached the highest limit of advancement in practice or theory. One of these reasons we will consider, viz., the boundless variations of inventive genius.

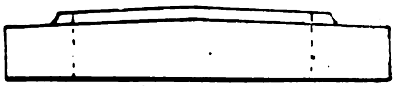
For example, a dozen men start in to do the same work. Each one has his own ideas and works accordingly. We find, during the progress of the work, that some of them are much farther advanced than others. The reason of this is obvious. Superior talent of applying the best methods to obtain sure and speedy results, has been used. We also find that it is a very rare occurrence for two men to do the same work the same way, in all of its different stages, therein showing the great variety of inventive faculties.

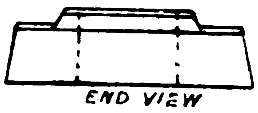
Again, the master mechanic may be a man of advanced thought, and well posted in everything pertaining to the trade, yet from the common workmen he is able to gather information, from day to day, that is new to him. The principles of the screw and lever were known in remote ages of antiquity, but their varied applications were little dreamed of.

From the above illustrations, we arrive at the conclusion that the theme is practically inexhaustible, and we can still find many useful things of every-day occurrence in the work-shop to write about, that will be a benefit to our fellow workmen, always bearing in mind that what is new to us, may be old to others and *vice versa*.

We will now introduce a brief lesson on making an ordinary die for the punch press, the object of which is to do the work well, and to reduce labor to its minimum. A good mechanic is recognized by his ability in this direction always—every motion must count, or he cannot compete with others. The first thing to be considered is the steel upon which we wish to operate. If it be hard we cannot make much headway. No matter how we try we can only reduce it by a slow and labored process. Most steel is unfit to work without first annealing. A simple and excellent way to do this is as follows: Just before the day's work is done, build a fire in the forge of charcoal or of wood, then heat the steel to a cherry red. See that there is a nice bed of coals to lay it in, then cover over with ashes until the steel and coals are completely imbedded. As a protection against fire, place a piece of sheet iron over also, weighting it down with pieces of iron. Leave it thus till morning, and it will be soft and easy to work, and also in better condition for hardening.

We will now proceed to make the die. Suppose the steel to be 5" x 8" x 1½", the aperture being 2" x 5". Plane on one side, taking no pains to have it smooth, for that is only waste of time. One side being true is sufficient. This being the bottom side, plane the edges to an angle of 5° or, same angle of the shoe that is to receive it. This can be done easily, at one setting, by clamping on the bed of the planer or shaper. Do not plane the ends, unless you wish to spend the time making your job look well; it is no use practically. This die needs about ⅛" shear, from the center each way, to do the work well. Now plane the shear, at the same time relieve the edges all round to within ⅜" of the aperture (that is to be cut in it), ¼" below, so as to allow for grinding. The die will now appear like diagram.


SIDE VIEW


END VIEW

The object is to do all the work we can while using any particular tool. If the workman takes it from the planer when half done, and drills it, when he returns his tools are scattered and everything has to be looked up again. After grinding the face a little it is now ready to lay out for drilling.

With the tinners' shears cut out a piece of tin the shape of the hole to be cut out, making it long enough to allow for the slight bend. Place it centrally and mark the die (the same terneplate will answer to lay out the punch). From these lines lay out the minor lines to center punch for drilling. Much time can be saved in laying out work for drilling by using a double center punch. The points being a little farther apart than the diameter of the drill, care should be taken to have the drill in proper shape. It should be ground central and the sharp lip taken off with an oil stone. When it is drilled, if properly done, the piece will almost drop out. Never use a chisel to remove it, if it can be avoided. A thin flat drift will do the work quicker, without danger of marring the face. Use the drift from both sides.

It can now be finished in the ordinary way, with which every machinist is acquainted, care being taken not to give too much clearance. The next step is hardening, wherein so many fail and destroy thousands of dollars' worth of work. In many instances the writer has seen costly dies ruined completely, by men that know it all and will not listen to the voice of reason or experience. Take great pains with the fire, have a good blast and if a portable forge is used (as many machinists have to), have a boy to blow so you can attend strictly to your work. There is no use to try and harden this die in a pail of water with any satisfaction, so you will have sufficient at hand. Now, with a pair of long-handle tongs, place it in the fire, turning it over and over, end for end, side for side, watching the heat closely. At night is the best time, as the variations of heat are more easily seen.

When you have an even heat (which is absolutely indispensable) place it on its face or top side a moment, then plunge it in the bath. Do not move it around or shake it in the bath. Keep it as still as possible until cool, remove and place it over the fire until it is warm. Then let it cool gradually, and in most cases you will have a hard, straight die. The object in warming it again is to prevent it from checking. The steel should not be heated so hot as to raise a scale. If good, it will harden well at a bright cherry red. Many use cyanide of potassium. When this is done, it should be with a pair of tongs without removing from the fire. All that remains to be done is to draw the temper, of which little need be said, as every machinist that knows how to make a die, knows how to do it. It should be drawn slowly.

A fluid used for the coloring of iron or steel is best made as follows: Take sulphate of copper (blue vitriol), put a handfull in an open-mouth jar, add water to it but not enough to dissolve all the sulphate, tie a small cloth on a stick and let it remain at the bottom among the undissolved copper. When using rub on quite hard, and the steel or iron will be coated with a bright coat of copper, that will not rub off easy or turn dark.

KINKS.

IN AND ABOUT THE SHOP.

What are you looking for, my son? A file? What do you want with a file? I thought the foreman told you to drill some half-inch holes, one and one-quarter inches deep in those oil covers? Surely you are too smart a cub to think you can drill them with a file. You say you want to make a mark on the drill so you will know when the hole is deep enough? Great balls of sweat! No you don't want to do anything of the kind. Suppose every man in this shop did that, the drills would soon be covered with file marks and not be worth decent junk. Who told you to do such a thing? Joe did, and he always did it that way himself? Well, don't ever pattern after Joe—he is not the smartest nor the wisest jour. I have seen in the business. He is getting two twenty-five per day but I don't think he will get it much longer here. He is too much of a slouch workman, and from the little I have seen of him I don't think he ever served much "time," and he would be more at home tamping ties on the Dry River railroad than he is on that thirty-inch lathe, trying to jerk that counter-shaft down with the shipper rod. I wonder what sort of a grudge he has against that counter-shaft, anyway? Now, my boy, let us see if we can't drill those holes without a mark and get them all alike. What machine are you going to drill them on? The big drill press, because no one is using it and Tim has the small one. No, you had better use the small fifteen-inch lathe over in the corner. Those caps are light and easily held and you can work faster and finish the job quicker, thereby helping your employer to make more profit on the time. What is the "pitch" of the screw in the tail-stock? You don't know what "pitch" means? And been working here two years? Well, I think I will be having a new foreman in this department before long if this is the way he educates the apprentices.

Pitch, when refering to a screw, means the number of threads that encircle it in one inch of its length. For instance, if there are four threads in one inch of its length it is called four pitch; if there are eight threads in an inch it is called eight pitch; see? Now you want to stow that away in your head where you can find it handy any time you want it in the future. Now go and find the pitch of the screw in that tail-stock. Eight pitch, is it? All right. Now suppose you had to move the spindle out one inch, how many turns would you give the handle? Eight. That's right. Suppose, only half an inch? Four, correct. Suppose only one-quarter of an inch? Two, right again. If it was to be two inches? Sixteen turns of the handle, certainly. Now, how deep are those holes to be and how many turns of the handle must you have for each hole? One and one-quarter inches deep and ten turns of the handle. Easy, is it not? Go and do it and bear in mind to always do it that way, remembering also that the pitch on various machines vary with the whims of their makers. It will also teach you to count and, better still, will teach you to keep your mind on your work, instead of having your brain power wandering around the shop and out in the foundry, or possibly down street five or six blocks, pondering on things connected with the surprise party at Billy Miller's house next week, instead of your employer's interests. And don't forget that "pitch" idea, remembering also that the same formula will hold good on a drill-press, too.

Some of our "modern" builders are putting on a jimcrack sort of a gauge on their drill-presses to regulate the depth of hole to be drilled; and, on special work going on all the year round and using unskilled help, it is a good idea; but in the general shop work it is just so much clap-trap to demoralize mechanics and make them worthless.

Say, you are not going to use a flat drill on that job, are you? You have always done it that way? They are brass, and should flat drills always be used for drilling brass? No, they should not. Twist drills are the modern tools for that work and for making holes. Get a twist drill, and we will try doing it that way and see if a flat drill is the proper thing to use.

You have got it? All right, put it in the chuck and go to work. You thought I wanted to do the first one? Why certainly not. I want you to do it, and I will look on and see if you do it right. It would not look very proper for the boss to be doing the work while the cub stood by and looked on. Beside that, you would not be learning how to do it half so well as you would if you did it alone. Then, the firm don't pay me to do the work, but to see that it is performed, and in the least expensive way with correct workmanship. Now, let me see you do the first one, not forgetting to count the turns you give the handle. That one is a good job. Just as good as if I had done it myself, too. Which would you rather use, a flat or a twist drill? The twist drill is easier, and you can do them twice as quick? Well, that is business, easier for you and more profit for the firm. You and I are doing some good to-day, aren't we?

But you must not always use a twist drill on brass just as you have this time. You see this hole did not go clear through. If it had, the drill points would have gouged through and jerked the work out of your hands, possibly injuring your fingers and probably breaking the drill or spoiling the work. When the hole is to go all the way through the work, you must grind the drill a trifle flat on the front side of the cutting edge, thus making the conditions similar to the flat drill; then you will make nice, good holes and make them quick, too. Now we will go on with our work, remembering what we have found out to-day to help us along in the years to come.

There are one million things to learn in the trade you have chosen, and as you have only nine hundred and thirty-six days to serve as an apprentice, learning one new kink per day, you can easily figure out how many will be left for you to learn after you have begun your life as a jour. By learning all you can now, you will have more time to study political economy intelligently after you reach manhood. You will thus be able to talk with intelligence on mechanical subjects as well, and will not bore the boys at the noon hour with a lot of ideas that are as ridiculous as drinking hard soap out of a jug.

THE OLD MAN.

Handy Apron for Mechanics.

The Cleveland Novelty Co. has designed and brought out one of the most handy and cheap articles for mechanics ever devised. It is an apron, called the mechanics' handy apron, made of canvas and so strong as scarcely to be capable of being worn out. They are warranted to wear a life-time. They are made adjustable, so that they will fit any man of any size. One great advantage of them is that they do not interfere with climbing or working in any position, and, when kneeling, they protect the knees. With pockets for tools, rules, and other things necessary to carry, they are really indispensable to a machinist, engineer, carpenter, or any mechanic who uses tools a good deal, and they will save their cost in time spent in hunting and running for tools, every week of the year. The Cleveland Novelty Co. will send a sample apron, post paid, for 60 cents. They want agents in every shop, and offer attractive inducements. The article, being one of the most useful and cheap ever gotten out, sells very readily. A cut of a man with one of these aprons on will be found on the back page. The address of the Cleveland Novelty Co. is 401 Society for Savings Building, Cleveland, O. If you write, it will be to your interest to mention the SCIENTIFIC MACHINIST.

A Correction.

In our issue of January 1st we stated, at the end of an article on "The Use of Milling Machines," which was taken from the recently published book of Brown & Sharpe entitled "A Treatise on the Use of Milling Machines," that any one who would cut out the notice and send it to The Brown & Sharpe Manufacturing Co., of Providence, R. I., by February 1st, and inclose 20 cents would get a copy in paper cover and by inclosing 50 cents they would get a copy in cloth binding.

This notice was partly a result of a misunderstanding, for which we are entirely to blame. The book in paper cover is 75 cents, and in cloth $1.60. Any one who sent for either of those bindings can have their money refunded by sending in their name and address, and the binding they sent for. We will refund them every cent expended, for postage as well as for the amount for the book. We regret that it occurred and that any inconvenience was caused any of our subscribers. We hope that no one who sent will fail to drop us a postal card so that we can make the matter right.

Save Your Tools.

How many valuable tools become stolen, or lost, because they do not have the owner's name stamped on them! Hundreds of dollars' worth a year in every shop, without doubt. Many machinists have tools worth $300, and sometimes more. If every one is stamped it will hardly do for others to keep it about them, and if lost by the owner and found by an honest person, the name will insure its prompt return. Many men do not know where to get the stamps. We invite the attention of all those to the advertisment of C. E. McCombs on the last page. Before buying more tools, better get some stamps and imprint your name, or your initials, on what you have. If you have occasion to write to the person referred to, kindly mention our paper.

The Cheapest First-Class Engine on the Market.

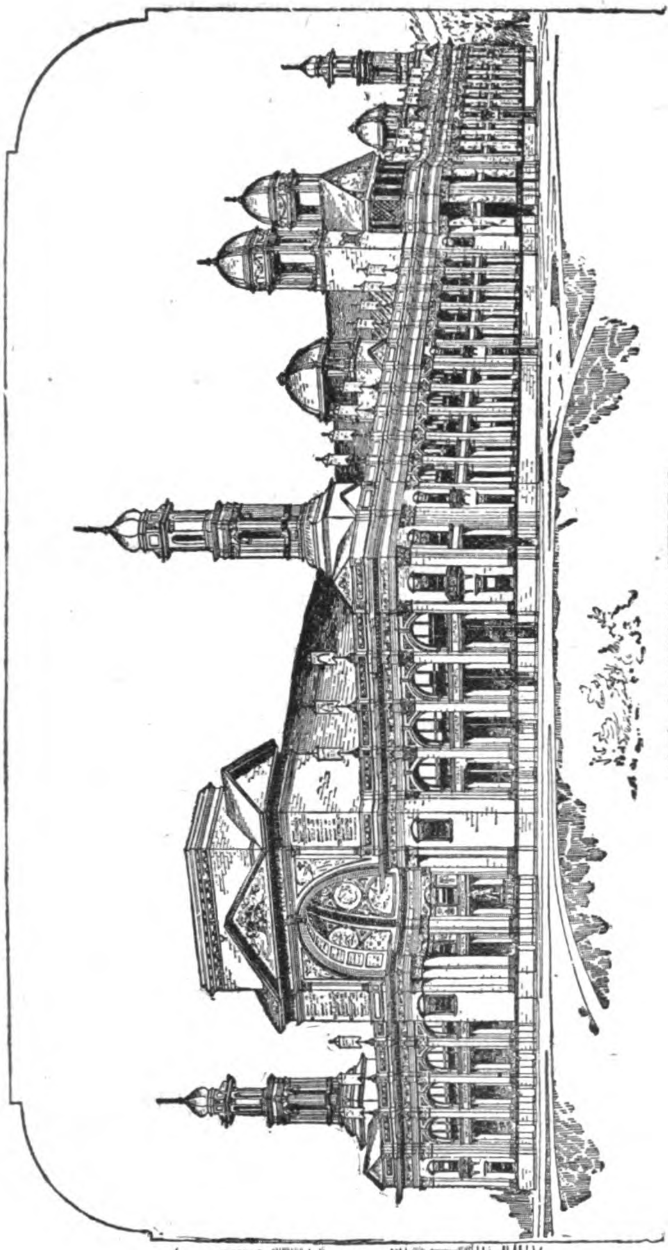
Mr. John Crowther, of Cincinnati, has for years been a manufacturer of slide valve engines. He has given the matter life-long study, and has succeeded in his aim, viz., to make a serviceable, strong, reliable engine at the very lowest price on the market. He is now making regularly up to eight horse-power, and can make larger on special ordes at proportionately low prices. We doubt whether there is another concern in the world that will make engines that are really first-class machines for as low a price. His advertisement is published on the 15th page, under the head of "Center Crank Engines." Mr. Crowther is the proprietor of the Globe Machine Works, which is the name used in the advertisement.

Edwards' Work on the Steam Engine.

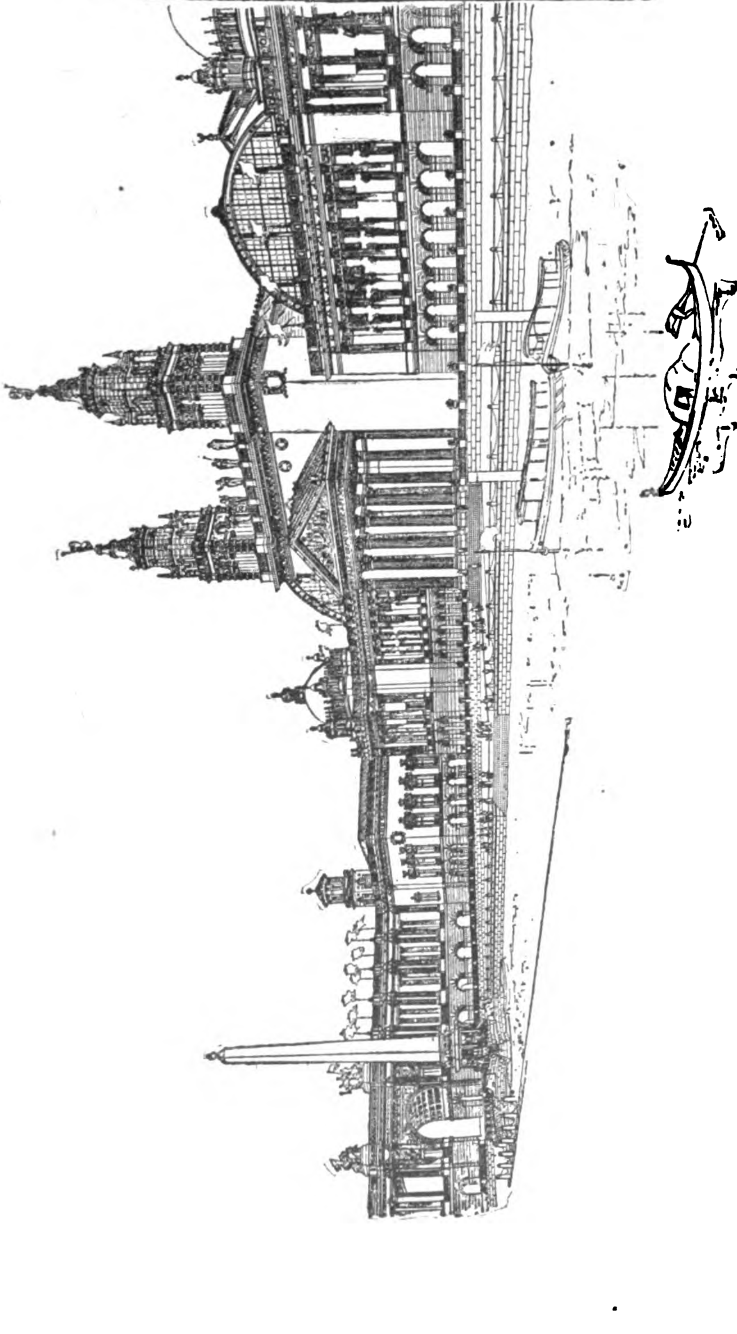
There are many works on engineering, but the careful mechanical editor can not always recommend them. Elsewhere in our advertising columns will be found, under the head of "Edwards' Work on the Steam Engine," a list of books on engineering, by the eminent author, Emory Edwards. His work on marine engineering is particularly meritorious, but his "Edwards' 600 Questions and Answers for Engineers and Firemen," covers the entire range of stationary engineering, and is, besides being a most reliable work, very reasonable in price, only $1.50. It will pay every man to look over this list and, at least, send for the catalogue of the publishers, mentioning the SCIENTIFIC MACHINIST.

HAWKIN'S Handbook of Calculations, for Engineers and Firemen, published by Theo. Audel & Co., 91 Liberty St., New York, an advertisement of which will be found on the back page, is a book which will greatly assist engineers in those every-day problems which come up.

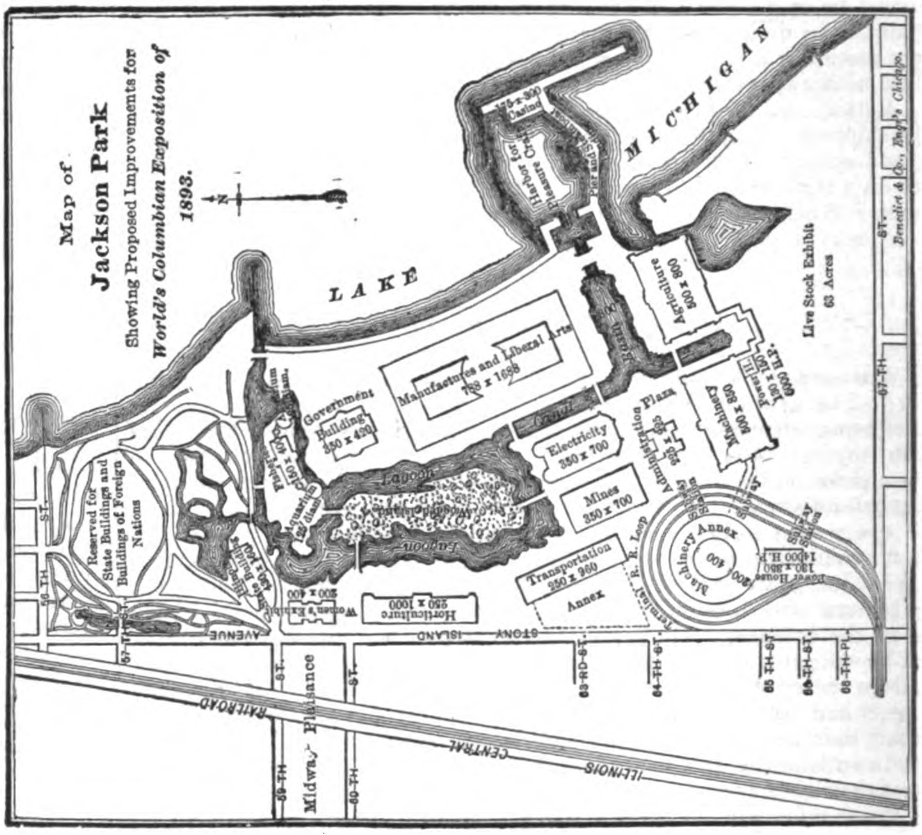
BUILDINGS OF THE WORLD'S FAIR.



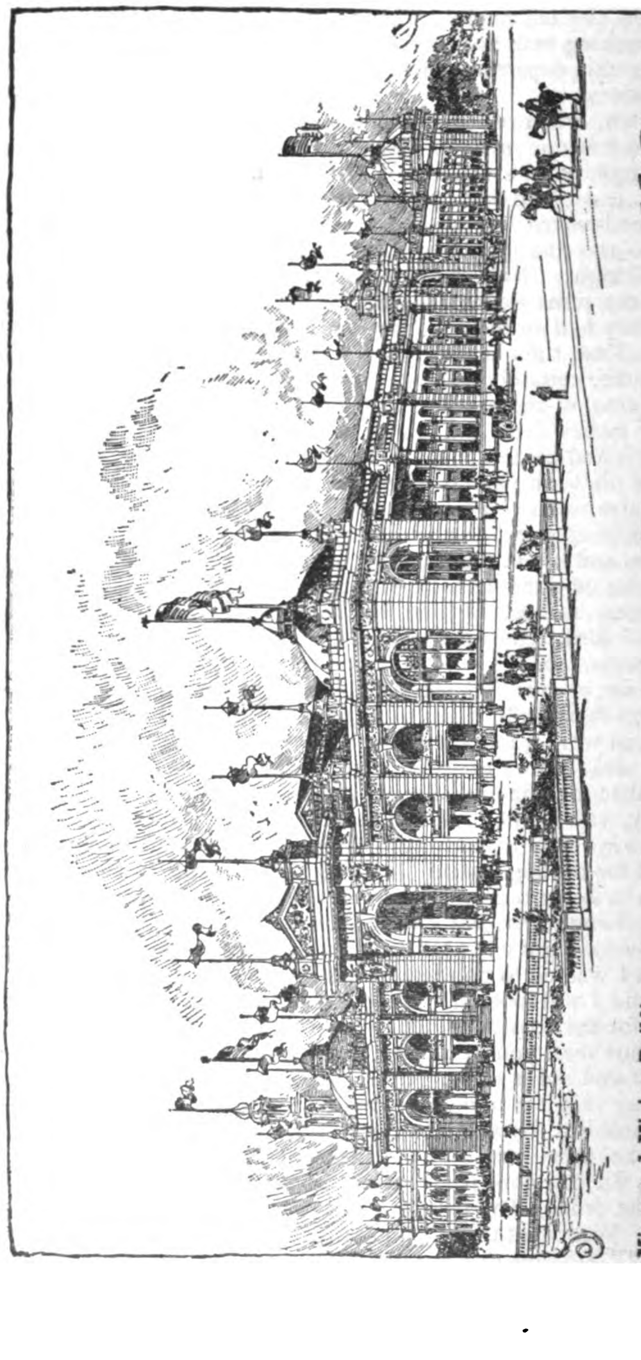
THE ELECTRICAL BUILDING.



THE MACHINERY HALL.



Map of
Jackson Park
Showing Proposed Improvements for
World's Columbian Exposition of
1893.



Mines and Mining Building. View taken from North-west.

Electrical

☞ *The Electrical Lessons recently printed, one of which gave directions for making a dynamo, will soon be completed, when the whole series will be published in a neat volume with paper covers. Every one subscribing after December 1st,* 1891, *will receive a copy free. This series constitutes the simplest and best instruction for beginners we have yet seen.*

Electrical Lessons for Machinists and Engineers.—XI.

SILVER PLATING.

Silver-plating is done by the dry and the wet process. By the dry process is meant soldering the silver (previously rolled into thin sheets) to the baser metal. The wet process, by electro-plating by the use of a saturated solution of silver and the electric current.

The electro-deposition of this metal is carried on similar to that of nickel, the difference being in the previous preparation and manipulation of the article upon which the coating of silver is to be laid or deposited. The latter process is the one which we will describe in this article.

The same precaution is as essential as in nickel-plating—*extreme cleanliness.* The same directions employed in the arrangement of the dynamo, its connections with the plating tank, etc., must be observed. Some plates use from half an ounce up to six ounces of silver to the gallon of solution. One ounce of silver to the gallon will make a very satisfactory plating solution, but a really good solution should contain as much as 2½ ounces to the gallon. This quantity of silver will plate anything. To prepare the silver bath, say for 20 gallons, containing one ounce of silver to the gallon, proceed as follows: in a two-gallon glazed crock, put 20 oz. pure grain silver. Add to this 20 ozs., by weight, pure nitric acid and 10 oz. rain water. Place the crock in a pan of water, place the pan over a fire and heat the acid mixture gradually, or until the acid begins to boil or effervesce. If it boils too rapidly, remove the crock from the pan of hot water until the boiling abates when it may be replaced. Continue this operation until the silver is entirely dissolved. It sometimes happens that the silver does not entirely dissolve, owing to the poor quality of the acid, in that case the operator will mix a small portion of the acid preparation in the proper proportion and add it to that in the crock a little at a time until the silver has entirely dissolved. If there should be a black powder settle to the bottom of the solution, don't throw away the black portion as it is pure gold and may be saved. After the silver has dissolved, fill the crock ⅔ full of water, then make a strong solution of two pounds of table salt dissolved in one gallon of hot water and pour a small quantity into the crock at a time, at the same time stirring the solution. This will produce a white curdled appearance. Allow this white mass to settle, then add a little more of the salt water and continue this until no more white precipitate forms upon the introduction of the salt water. This white precipitate is chloride of silver. After the chloride has settled to the bottom, carefully pour off the water—being careful each time *not* to disturb the chloride. Fill up the crock again with water, allow the chloride to settle and repeat the operation about six times or until you cannot taste a trace of the salt water. In the operation of dissolving the silver, red fumes are formed which are very dangerous and care should be used not to inhale such fumes.

To prepare the plating solution a quantity, say 120 ounces of c. p. cyanide of potash is now dissolved in five gallons of hot water. This cyanide water is then added to 15 gallons of water in your plating tank and the prepared chloride of silver added thereto. The solution thus prepared is then well stirred and then let stand till the following day to complete saturation, when it is ready for use.

Silver strike.—Now take one quart of the above solution put it into a crock with two pounds c. p. cyanide of potash and three quarts of water.

Mercury dip.—One ounce of mercury dissolved in one ounce of c. p. nitric acid. After the mercury is dissolved, pour it into a crock containing four gallons of water in which has been dissolved two pounds of cyanide of potash.

Articles of brass, copper or German silver are first polished or buffed, the same as for nickel-plating, placed in the potash to dissolve the grease, then rinsed in clean water, then into cyanide water, then again rinsed in clean water, then lightly scoured with fine pumic, again rinsed in clean water, then plunged into the mercury dip for an instant, rinsed again in clean water. Attach the wire (which is fastened to the article to be plated) to the plating rod on the silver strike and immersed in the liquid. Let it remain about ten seconds, or long enough to whiten the article, then quickly remove and place in the large solution until a sufficient quantity of silver has been deposited, when the article is then removed from the bath, rinsed in hot water and dried in boxwood sawdust.

The quickest way to impart a fine finish to articles so plated is to polish them on a fine cotton flannel buff charged with rouge. About ten hours immersion will deposite a first class coating of silver.

On the anode rod of the plating bath must be hung four strips of silver about 1 x 4" long by 1/16" thick. In the silver strike, a piece of silver must also be placed. Great care must be taken in plating with silver, to use a very light current of electricity. There should be no effervescence at the article like their is in nickel-plating. When a heavy current is used, the silver is liable to strip or peel off.

In plating steel or iron, great care should be taken as those metals are the hardest to plate, silver and iron being very antagonistic.

The easiest and best way for the beginner is to first nickel the article, then place into the mercury dip, from the mercury dip into the silver strike and then into the silver solution, the same as for brass, etc. The mercury dip will require renewing occasionally as it becomes impoverished by the loss of mercury and evaporation. When the silver strike commences to work in an unsatisfactory manner, it will need a slight addition of cyanide. The large plating bath, if used continually, will require small additions of cyanide about once a week, and also one ounce of chloride of silver may be required to give it metallic strength. If the metal does not deposit good, look well to your wire connections. See that all the points of contact at the binding posts are perfect. If the connections are not perfect the plating will be faulty. This precaution is absolutely necessary in plating with all metals. In a future issue we will describe gold-plating, the most interesting part of this art.

To the Reader: If not a subscriber you should subscribe for this paper. It contains more matter of merit for the price than any other mechanical journal. See our REMARKABLE offer on page 8, which holds good only a short time. Don't fail to take advantage of the best bargain you will ever strike.

DO YOU USE VALVES?—IF SO READ THIS.

The Lunkenheimer patented regrinding globe, angle and check valves are heavy, substantial valves of superior quality, made from a special steam composition. They will outlast two of any ordinary make, and when worn in the seat can be reground, or disk replaced, thus making them as good as new. As a proof of their superiority they are extensively used on Government work, steamboats, locomotives, rolling mills, refineries, etc. All genuine valves have "Lunkenheimer" and "(S)" cast in the valve shell, and are fully warranted. The accompanying cuts show these valves.

In regrinding, the large nut is unscrewed and a little powdered sand and soap are placed on the disk. A wire pin is put through the hole in the disk to hold it to the stem, and the regrinding is then carried out, the nut being left unscrewed, so that the hub will guide the stem.

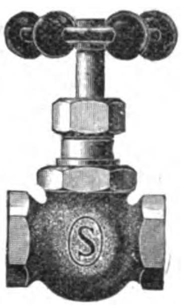


FIG. 200.
Regrinding Globe Valve.

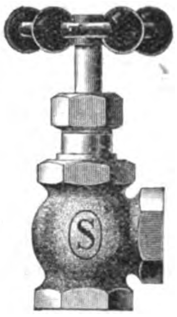


FIG. 201.
Regrinding Angle Valve.

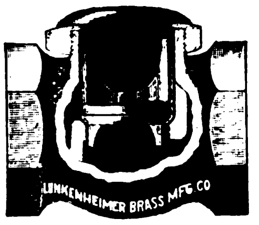


FIG. 205.
Regrinding Check Valve.

These valves are for sale by dealers or the Lunkenheimer Brass Manufacturing Co., 25 East 8th street, Cincinnati, O. Catalogue of valuable and interesting specialties to be had upon application.

Lightning Conductors.

To the various theories concerning lightning conductors which have been advanced by scientists is now added that of Prof. Rowland of the Johns Hopkins University, who asserts that the best method is to provide a metal roof with an ample number of metal conductors leading to the ground, serving to carry off the electric bolts from the clouds; copper is the best material, but tin or iron will answer the purpose, and he suggests the placing of the conductors at the corners of a building, so that all parts will be equally protected. Further, lightning has no fixed portion on a building to strike—the stroke may fall at the centre of a roof, and, while it runs along the surface of a body, the body may be broken or crushed by the enormous pressure brought to bear upon it, in the same manner that an explosion of dynamite or nitro-glycerine would cause a fracture. The quantity of electricity in a stroke of lightning, Prof. Rowland remarks, is not nearly so much as passes along almost any electric wire on the street, but the voltage, or electrical pressure, of the street wire is rarely 3,000; a volt is the basis on which the pressure is estimated, and the voltage of the lightning stroke is roughly estimated at 6,000,000,000 volts—in addition to which appalling difference, it may be said that the current of the wire is constant and continuing, while the lightning dart is delivered in the one two-hundredth part of a second.

Catalogues, Etc.

The following circulars, pamphlets and catalogues have been received:

A report of the Board of Engineer officers of the navy, on Ward's Water Tube Marine Boiler. It is well illustrated.

Merchant & Co., of Philadelphia, Pa., have issued a most artistic catalogue or rather souvenir, mentioning the various articles of metal goods they manufacture.

"The Twenty Foot Channel," is the tittle of a pamphlet written by W. A. Livingstone, and published by the Detroit Dry Dock Co. It gives some interesting facts concerning the channels of the lakes, the growth of lake commerce, etc.

A pamphlet of the classification of the Department of Transportation Exhibits of the World's Columbian Exposition, has been issued by the Director-General.

The Eureka Tempered Copper Co., of North East Pa., have issued a new catalogue of their tempered copper goods. It is an interesting one.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(314.) H. F. M., Gypsum City, Kan., writes: "Will you, or some of your readers, please give me a rule for arranging the gears on a screw-cutting lathe to cut 17 threads? Lead screw pitch is 10 to the inch, and the gears I have are 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56 and 88. It is a Barnes No. 4½ lathe. By doing so you will greatly oblige one of your readers at least, if not more of them." *A.*—Divide the pitch to be cut by pitch of the feed screw and the product is the proportional number. Then multiply the number of teeth on the mandrel gear by the number of teeth on the smaller gear of the compound pair, and the product by the proportional number, and divide the last product by the number of teeth in the larger compound gear, and the quotient will be teeth in gear on feed screw. You can not cut 17 threads to the inch with the above gears. Would be pleased to have any of our readers, who will, give the inquirer any information they think will help him.

(315.) Eddie Howland, Cincinnati, O., writes: "I suppose you will think that any boy ought to know where to go to learn to be a good machinist, but we were discussing it here, and many different ways were spoken of, but my brother told me to write to the editor of the Scientific Macainist, which he takes. Now, I don't want to ask about starting, for I have been a year at it, but whether I ought to go on a lathe, doing one job from one month to another, when I can get $2.12½ a day, or to continue as a 'cub.' Some of my family want me to go on the lathe and get the higher pay, and really that is what I would like to do myself, but my brother thinks I should continue with my trade, telling me that he will get me a place in a small repair shop, where I will have experience on all kinds of jobs. Now, I ask you to tell me what to do—go on the lathe, or go in the small shop. I want to do the best thing for the future." *A.*—Go into the small repair shop, and when you get an application to leave school, where you will be in a small shop, and neglect your education for a job of hand work and imitation, pure and simple, such as much of the machine work you refer to is, just tell the party who makes the offer that as long as you can get even small pay for attending school you will not, till the course is finished, leave it for a job of manual labor.

(316.) J. K——a, Wadesboro, Ky., writes: "Please be kind enough to inform me in the next edition of your paper the best way for cleaning rust off an engine. The former engineer let her get very rusty, and in some places scales of dirt and grease are found." *A.*—Soak the parts with strong caustic soda or lye. It is best to do this when the engine is cold. Then, after washing off the lye, scour with fine emery paper.

(317.) C. B. V——h, Portland, Me., asks: "How would you go to work to harden cast iron?" *A.*—There are many methods. We have given several in previous issues, and to avoid repetition we give another as follows: Heat the iron to a cherry red, cover it with potash and dip into water, repeating the process several times. Pulverize the potash so that it will melt, and in re-heating be careful not to burn it off, or the iron will remain soft.

(318.) J. W——n, Manitowoc, Mich., writes: "1. I have been a subscriber to your paper about four years and would not be without it. I want to ask you or some of the readers of your paper, the best way to temper planer knives to keep them straight. I have trouble with some knives 18" and 24" long. They curl and twist every way while cooling. No. 2. Would like to know where I could get iron or steel balls ½" and 1" diameter; will use a great many." *A.*—The planer knives will not bend or work if you immerse them in the cooling liquid evenly all along the blade. 2. We know of no firm that manufactures iron balls such as you speak of. Probably some of the foundries advertised in our columns will make them.

(319.) L. J. B——d, Sharon, Pa., writes: "I want to glue a piece of leather to a piece of cast iron. I have asked a number of mechanics how it might be done, and have tried many receipts, but none of them work. Now, I would like to know if you can help me out." *A.*—To glue leather to iron, paint the iron with a mixture of white lead and lamp-black. When dry, brush it over with a cement made by soaking the best glue in cold water until soft, then dissolve it in vinegar at a moderate heat, mixing with ⅓ its bulk of white pine turpentine, making it the proper consistency by the addition of more vinegar. Apply when hot.

(320.) J. M. C., New Haven, Conn., asks: "Has there ever been a solder of aluminum discovered? A constant reader of your valuable paper would like to know." *A.*—An alloy of tin and aluminum is said to form an excellent solder for both metals.

(321.) Oscar May, Terre Haute, Ind., asks: "What can be done to keep glass from being blurred by condensed steam?" *A.*—A thin coating of glycerine on both sides of a pane of glass will prevent the condensation of steam that would otherwise obscure it by rendering it translucent. Engineers, surveyors and others who use scientific instruments in a moist atmosphere will find this worth knowing.

(322.) C. B. Perkins, Detroit, Mich., writes: "How can the ink on drawings be prevented from running, when they come in contact with dampness, or receive a color wash?" *A.*—When a color wash or dampness comes in contact with the lines in a drawing, the india ink is apt to become blured or run. This may be prevented by dissolving in the water used for rubbing up the ink, about 8 grains of bichromate of potassium, to every ounce of water.

(323.) John Dover, Cleveland, O., writes: "Would be pleased to have you tell me through 'Questions and Answers,' whether zinc will melt, and how much it will expand." *A.*—We cannot answer this question fully and explicitly without devoting too much space, but it will probably be sufficient for the inquirer to know that zinc will expand with heat until it melts, and that a bar of hammered zinc, six inches long, will expand one-tenth of an inch in being raised to the temperture of 100° Fah.

(324.) "Interested Reader," Richmond, Va., asks: "How may varnish be removed from wood?" *A.*—To remove varnish from wood apply a mixture of one teaspoonful of spirits of wine and ½ teaspoonful of turpentine. If not strong enough add more spirits of wine.

THE MORAL RIGHT.

BY FRED H. COLVIN.

We often see discussions regarding the legal rights of both employers and employed, and the law in such cases having been expounded by eminent authorities, it would be useless for me to attack that problem.

But legal right is not all by any means, and there is a factor in the problem of measuring out justice that is too often neglected; by that I mean moral right, the observance of which is true justice.

There appeared some time ago in the *American Machinist* an insurance scheme, proposed by Brownell & Co., of Dayton, O., which appeared on the face to be a very good and thoughtful plan for the protection of their employes, but which proved to be a plan of the compulsory type in which you must be protected whether you wish to or not.

In the issue of December 11th, the compulsory idea was thoroughly discussed and it was with great pleasure that I read the just and manly criticism of the proposed coercion.

This brings us to the direct question of moral right or obligation.

Any one has the legal right to formulate any code of rules for his own employes, and they can either obey them or go elsewhere for work, but has any man a moral right to compel men to obey some arbitrary set of regulations that are unjust as well as unwise?

There are many factories that have rules and regulations that are as unjust as any of the "Blue Laws" of the old Puritanical days. Among them is the Keystone Watch Co. who will not employ any boy who is not connected with some Sunday-school, or recommended by some teacher of the same.

This may be legal, but is it right?

Is it right to prevent any one from earning a living because he happens to hold views different from the proprietor or from the public generally?

This is persecution for opinion's sake, and is denounced by all fair-minded men, regardless of sect or country. The sects that uphold it are not composed of men of the highest type of intellect or manhood.

Persecution applies to many of the restrictions that are placed on men by foremen or proprietors in little matters that infringe one's liberties without benefiting any one, merely to satisfy some whim of the petty tyrant in charge.

To try to prevent an employe from joining any organization is a form of this ever-present persecution that is often attempted, and for which there is no reasonable excuse.

That any number of men may join together in any enterprise is an acknowledged right, and does this not apply to all men with equal force as long as the laws are not violated?

It will not do to say that there is danger of it, for all men are innocent until proven guilty, and this must apply to all classes or to none.

While the right to organize must be given to all, the injustice of conspiracy cannot be too strongly condemned, and the organizations that allow this form of injustice are as much to be condemned as the employers in the cases before mentioned. In no place more than this is the old saying of "put yourself in his place" more applicable.

In order to more fully illustrate the subject in hand I will mention one or two cases that have come to my notice, the first of which is as follows:

A shop was heated, or supposed to be heated, by steam, and yet was often so cold that the thermometer stood at 38° to 44°, and men were expected to be ready to commence work on time as usual.

Every one knows the danger of even partly undressing in a cold room, yet this must be done here in order to work at all.

The question is, whether the proprietor is not morally responsible for all sickness caused by such an inhuman state of affairs, or whether the man is in fault for undertaking work under such circumstances.

But this can easily be settled, I think, for in a measure the workman is compelled to work, if possible, in order to provide for the one's dependent on him and cannot leave a job as easily as might be imagined.

Then it seems that the proprietor, and he alone, is at fault, for it lies in his power to make the shop rooms comfortable and healthful; the penalty for neglecting the same is, or should be, the contempt of every lover of justice.

Such small and miserly actions seem hardly credible, yet they are practiced every day in every city in the land, and usually by the very men whose names head the subscription list of churches or are donors for the conversion of the heathen. To all such the motto "Be just before you are generous" is doubly applicable.

There are two sides to every story, and this applies to shops as well as anywhere, and the question of "right" is not confined to one side of the case.

It often happens that the men are guilty of injustice, either in demands or in lack of interest in their work, and to them as well as the employer this appeals.

It is often asked "What is liberty?" and the best answer I know of is the oft-repeated one, "Allow every one the same rights that you ask for yourself," or "Respect in others the rights that you demand for yourself." Either is good, and fills the bill exactly.

But it is sometimes asked, of what use is any organization if it cannot use the weapons of boycott or combination, as is usually done in most labor organizations of to-day, and the answer must be that argument or moral suasion must ultimately be the manner of settling all difficulties, whether it be between nations or individuals.

The influence of surroundings on the actions of men in all walks of life can hardly be over-estimated. In other words, the moral influence is strong enough to alter the actions of a man in many cases, and too often the intention to act in a thoroughly just manner is made to conform to the actions of those around him.

The moral right of any man to curtail or deny the liberty of another is questioned by all thinkers even though the law may give its sanction to the act, and it is the recognition of this right that must settle all labor as well as other difficulties.

The right to discharge a man without cause is also questioned, or without informing him of the cause of his dismissal from service.

New Catalogues.

The new catalogue, illustrated, entitled "The Graphite Productions of the Joseph Dixon Crucible Co.," is a very neat one and shows the great enterprise and progress of that firm. It gives the latest details of Dixon's Graphite Lubricants, Dixon's Crucibles and Stove Polish, Dixon's Plumbago Facings, Dixon's "Silica-Graphite" Paints, Dixon's "American Graphite" Pencils (with one of which this is written), and other manufactures. It is a neat volume.

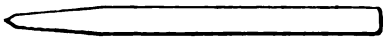


Fig 6

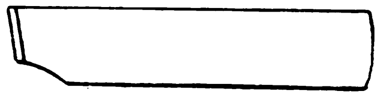


Fig 6a

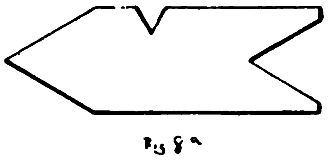


Fig 8a

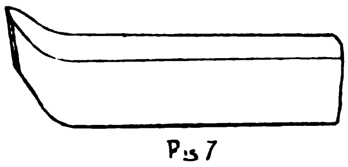


Fig 7

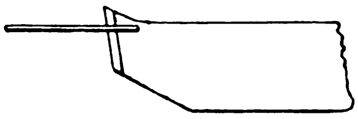


Fig 9

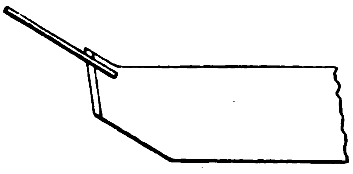


Fig 10

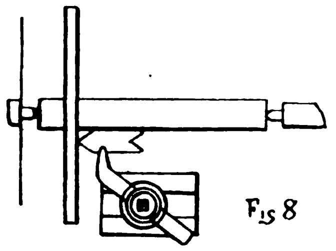


Fig 8

The second edition of "Rapid Lathe Work," by The Jones & Lamson Machine Co., of Springfield, Vt., is before us. It is, in the first place, a very artistic work. It gives information that every lathe owner and user should read, for it will be to his profit to do so. The finest kind of illustrations are used, and the chapter "Comparisons between the flat turret lathe and turret lathes of other makers," is especially instructive. The samples of work done will alone well repay the trouble of sending for one. Take it altogether, "Rapid Lathe Work" is something every reader should have. It can be procured by simply dropping a postal card to The Jones & Lamson Machine Co., Lock Box 61, Springfield, Vt., and mentioning this paper.

The latest catalogue of the J. Stevens Arms & Tool Co. is a fine one. It will pay any mechanic to have one. The agency for Stevens' tools in a shop is worth a good deal to a live man. Mechanics will do well to write for prices. Address, J. Stevens Arms & Tool Co., Box 216, Chicoppee Falls, Mass., and mention this paper. The regular advertisement of this company is on the 16th page.

The calendars of the Universal Radial Drill Co., of Cincinnati, O. come this year in more artistic form than ever. The editor of the SCIENTIFIC MACHINIST changes his every month, hanging in place of the old one the new one that always arrives promptly from the Universal R. D. Co. The pictures of the tools of the company on these calendars are neat and first-class, like the machines they represent.

In Court.

THE case of Geo. Faulhaber *vs.* Chas. Roehr & Sons was heard in the U. S. Circuit Court, in this city, on Monday last, and a preliminary injunction entered against the defendants. This is to restrain them from manufacturing what is known as the "True Curve Circular Pew." Messrs. M. D. & L. L. Leggett and A. E. Lynch, of Cleveland, attorneys in patent law, represented the complainant, Mr. Faulhaber, the inventor of the pew.

BOLTS AND SCREW THREADS.—V.

BY EDWIN WOODWARD.

If a solid thread tool is used and the work will admit of it, use a straight tool, Figs. 6 and 6a showing top and side views respectively. But if the thread runs up to a shoulder or collar a bent tool must be used. Obviously the tool must bend either right or left—the direction being determined by the position of the thread—whether on the right or left of the shoulder. Fig. 7 represents a bent tool for cutting threads on the right side of a collar. The bend permits the point of the tool to be brought up at right angles with the work, and admits of the carriage and tool post being far enough to the side to give ample clearance, as shown in Fig. 8, which also illustrates the manner of setting the tool correctly by means of the center-gauge, Fig. 8a.

That little tool, the center-gauge, is absolutely indespensable to the latheman, if accurate threads are desired. It is not only essential in setting the tool square with the work but it is equally necessary in maintaining the angle of the cutting edges of the tool. Though taking its name from its office of keeping the lathe centres the coned shape, it is eminently a thread tool, being probably used to test the truth of the thread or tool a score of times to once on the lathe centres.

In grinding a thread tool sufficient clearance must be given to the side of the tool that in advancing with the quickness of the thread that the side may not touch the thread, but be back of the cutting edge two or three degrees, as the angle of the thread requires. Tools for right and left threads—one must necessarily be the opposite of the other, although it is the practice of some workmen to grind the tool with sufficient clearance on each side to be used for both. But the practice greatly weakens the tool, which at best is the frailest of all the lathe tools, and is therefore not advocated. Nothing is lost by having a tool for each, and then they may be the most perfect of their kind. In grinding the angles on the tool the thread-gauge should be placed parallel with the body of the tool to test its angle, as shown in Fig. 9. If placed in line with the cutting edges, as Fig. 10, the angle will not be correct, but will be more than 60°, the increase being dependent on the height the gauge is elevated.

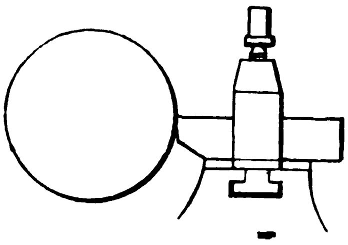


Fig 11

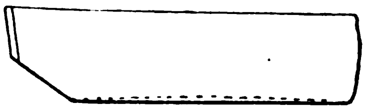


Fig 12

As a rule, but little top rake is given to thread tools, for, as before stated, the tool is weak at best, and top rake still reduces its limited strength, and if given it is better done after the sides are ground. In setting the tool its height should be such as will bring the cutting edge on a level with the center of the work. If level with the center the thread will be cut the right angle. If set below, the effect will be the same that holding the center gauge at an angle with the tool in grinding has, viz., the thread will not be deep enough, the angles of its faces being more than 60°. Setting above the center has the same effect, if it is done. However, this is not so often done, the clearance usually being not sufficient to cut freely; but the damaging error in this respect is the tendency of the tool or work to spring—the tool gouges, tears out and spoils the work, or breaks the point off the tool.

In setting the tool for a taper thread, the tool must not be set square with the surface of the work—a thread something of the nature of a reversed ratchet thread would thus be formed—but should be set square with the center of the work. In lathes having a taper attachment this is easily accomplished by placing the center gauge on the projecting end of the tail spindle to set the tool by, if the work has no parallel surfaces, and with the set-over tail stock the same end is accomplished by placing between the centers, in place of the taper work, a parallel piece the same length, and set the tool from its surface. If the taper work has a straight portion to it, apply the center gauge to that portion.

In setting the bent thread tool, it will be observed that as the thrust of the tool is not in the direct line of resistance between the work and the tool post it has a tendency to twist or turn from its hold and thus destroy the angle, and the coned pitch of the thread, which will be greater if the point be ahead of the carriage, and less, if it is behind. To obviate this in a measure when setting the tool, turn the tool post around till the side of the slot abuts against the back of the tool at the cutting end, while its opposite side bears against the front side of the tool, at the back end.

The tool should be flat on the bottom or it is liable to tip or roll in consequence of the side strain. All thread tools, straight or bent, as well as turning tools, should be slightly curved on the bottom side as shown in Fig. 12, that its bearing may be sure to be well out from the tool post and so reduce the liability to tip as much as possible. In screw cutting no precaution that adds to the stability is wasted. The centers in work after being drilled should be countersunk to the true angle. It is slop-shop workmen that fit up the centers drilled by driving in a center punch to countersink. Center punches may be ground the true angle, but are never round, and no matter how often they are turned in driving, the lathe center will show up the irregularities in one or two revolutions, and where the loose place comes will hrow over and make the work out of round.

Practical Letters.

Old vs. Young Mechanics.

EDITOR SCIENTIFIC MACHINIST:

Antipathy, perhaps, is a severe term to express the feeling that exists in the shops and elsewhere between the old and young mechanics of the present age. Nevertheless, such is the case, and it requires no great amount of study or observation to detect it when these two classes come in contact. It is not my purpose in this writing to say why there is such a feeling, but to say it should not be so, and to suggest that a few moments' thought and reason on the part of the older workman would largely do away with this, in many cases benefit the young man, and adorn the former with that manly bearing he should possess.

The young man, in serving his time and long after, meets with many disadvantages in the way of not having done, or not even having seen done, the work he is now asked to do. With his limited experience he naturally goes at it in an awkward manner, and right here is where the older and more experienced hand has the opportunity of showing that charitable feeling that should characterize and control the human race, by approaching him and offering his assistance, and not allow this feeling of superiority and opposition to influence his action.

And, again, care and judgment should be exercised in approaching the inexperienced shop-mate so as to cause no offense, and I feel quite sure when he realizes how you so ably assisted him, he will always, in the future, appreciate the kindness and respect you have shown him, and at some time later on perhaps it will be profitable and convenient to exchange ideas with this young man. For this reason and many more, this feeling should not exist, and if the older mechanic of to-day would take this view of the matter there would be no such feeling. On the other hand, it is not impossible for the young man to have in him the making of a better mechanic than any of his associates, and, therefore, need no assistance. In this case he will in all probability be given the choice or particular work of the shop. It is then very easy to detect this stored enmity, and it comes forth in such expressions as "he's a pet of the boss," or "he has rich relatives, which gives him preference," etc. And I say to those who use such language, you show not only your malice but ignorance also, and destroy any good quality you might have in other directions.

It is much more becoming the older mechanic to encourage the young man, and accept the situation philosophically.

A very few years ago, a gentleman of my acquaintance was called in a large manufacturing establishment by the proprietor to pass opinion on some shafting which had just been put up by one of the oldest machinists in the city. It consisted of two lengths of 2½" and 12 and 16 feet long, set at right angles, connected by a pair of miter wheels, and in consequence of their making such a racket the shafting was standing still. As it was always his custom to be very cautious in expressing an opinion on the work of others, he suggested the mechanic who put it up be called in. This the party said he had done, and was waiting for him, but wanted the opinion of some other mechanic, as the contractor had pronounced this shafting all right. Upon his request my friend, with the assistance of the engineer, removed the pulley and gearing and took the measurements generally used in such cases. When through he pronounced the shafting 2⅝" out of line, as we term it. And to his surprise, as he addressed the proprietor, there stood the gentleman who had put in the job, with a square on his shoulder about 4x6 feet, and the only recognition my friend received from him was the expression, "I do not want boys to inspect my work."

In conclusion I should like to say that my friend was called again by the proprietor to adjust the shafting just spoken of, according to his method, and when done it was quite satisfactory. This is the way he did it. After removing the gear and pulley he used a steel tape to get the exact lengths of shafting, which was 16 feet and 12 feet, bringing the ends together. He used the familiar rule in square root to find the hypothenuse of a right angle triangle, which is to extract the square root of the sums of the known sides to find the third, or hypothenuse, mathematically expressed:

$$12^2 + 16^2 = 400 \qquad \sqrt{400} = 20 \text{ feet.}$$

So, 20 feet was the distance that it should have measured at the hypothenuse to make the shafting at perfect right angle, and to run smooth, whereas the distance was 20 feet 2⅝", thus causing the trouble.

E. DE UNGER.

Please Explain.

EDITOR SCIENTIFIC MACHINIST:

I read with interest the article by J. J. Sand, and think the kink of making the screw driver handle or shank straight, a good one. They will certainly hold more and be less liable to turn than when tapered in the usual way.

However, his worm-wheel part did not quite strike my fancy. Now, as we have to cut the hob in our lathe, why can we not cut the worm there as well as to cut the hob for the wheel, and then cut the screw by a worm? Will Mr. Sand please explain, and also describe cutting the worm by the use of a hob, and tell us where the great advantage comes in?

I always believe in asking questions when you want to know anything, and not be afraid of showing somebody that you don't know it all. Nobody thinks you do, and you are only deceiving yourself when you think they do. It will be to the interest of all the readers to discuss the articles that appear, if anything is presented that does not agree with our ideas on the subject.

The kinks and ideas that come out of the little shop are oftentimes the best, so do not think that because you work in a small shop you cannot write anything that all the rest don't know. You can give them points on much of their own work, for you have had to use brains as well as tools; had to think out each job, while they have had the tools all provided, and only to go ahead and do the work.

You who are in this worm-wheel business or gear-wheel business; come and tell us all, Mr. Sand included, how you do your work. We can all learn something, even if we do know part of what you write, and every little kink counts when it comes to making up a man's store of useful knowledge. Don't be bashful, but let us hear from you. H. L. Chapman's drawing board kink was well appreciated, also the soldering board. Send more of them—they are all useful.

FRANK LYNN.

To the Reader: If not a subscriber you should subscribe for this paper. It contains more matter of merit for the price than any other mechanical journal. See our REMARKABLE offer on page 8, which holds good only a short time. Don't fail to take advantage of the best bargain you will ever strike.

The Meyer Recarburising Process.

In the *Genie Civil*, M. E. Demenge describes a method of direct recarburising used by Herr Meyer, at the Dudelangen works, in the grand-duchy of Luxemburg, as applied to rail steel. Finely powdered anthracite mixed with 10 per cent. of milk of lime is molded by hand into bricks of ordinary building size, which are allowed to dry for a few months. When the charge in the basic converter is shown to be sufficiently dephosphorised by the ordinary method of testing, the slag is removed, and ferromanganese, with 80 per cent. of manganese, in the right proportion for deoxidising the overblown metal (0.5 per cent., or 90 lb. for an 8 ton charge), is thrown in, a few minutes being allowed to enable it to melt and diffuse through the mass. During this time the ladle is prepared by throwing in 90 lb. of the anthracite bricks, which are crushed by a rammer and distributed uniformly over the bottom. In pouring the charge, a workman is placed on each side of the crane platform with a rake covered with refractory material, in order to prevent the slag in the converter flowing out with the metal, and the foreman, by means of the hydraulic mechanism, keeps the ladle slightly on the move both longitudinally and transversely, in order that the jet may impinge upon different parts of the surface successively. A violent reaction and evolution of carbonic oxide takes place when the metal meets the carbon, and for this reason the pouring must be done slowly at first in order to prevent the ladle from boiling over; but at a later period the reaction is beneficial for the stirring action of the gas promotes uniformity in the finished steel. When the casting is completed a portion of the slag is allowed to follow, so as to protect the metal against the action of the air, and the teeming into the ingot molds follow at once. The ingots obtained are perfectly sound and compact. A cast intended for rail making of the following composition:—Carbon, 0 52; manganese, 0.45; phosphorus, 0.075; silicon, 0.00; and sulphur, 0.013 per cent.—gives a tensile strength of 40.13 tons per square inch, with 18.5 per cent. elongation. The same process has been successfully applied to the production of the hardest steels with 1.5 per cent. of carbon. The economy realised is considerable as compared with the method of recarburising with spiegel, 12 cwt. of the latter metal, which was formerly required for an 8-ton charge, being now replaced by 1 cwt. of dry coke, and the amount of ferro-manganese required is also reduced by one-half.

Is Iron Rust a Cause of Fire?

When oxide of iron is placed in contact with timber excluded from the atmosphere, and aided by a slightly increased temperature, the oxide will part with its oxygen, and is converted into very finely divided particles of metallic iron having such an affinity for oxygen that, when afterwards exposed to the action of the atmosphere from any cause, oxygen is so rapidly absorbed that these particles become suddenly red-hot, and if in sufficient quantity will produce a temperature far beyond the ignition point of dry timber. Wherever iron pipes are employed for the circulation of any heated medium, whether hot water, hot air or steam, and the pipes are allowed to become rusty, in close contact with timber, it is only necessary to suppose that under these circumstances the particles of metallic iron become exposed to the action of the atmosphere—and this may occur from the mere expansion or contraction of the pipes—in order to account for many of the fires which periodically take place at the commencement of the Winter season.

New Uses for Compressed Air.

A company in Paris for the supply of compressed air have made an important new departure in the inauguration of a large factory at the Porte D'Ivry for the purpose of placing a regular supply of compressed air at the disposal of consumers in every part of the capital. By this means private individuals, as well as manufacturing houses, can have motive power laid on to their dwellings or workshops, and adapted to their requirements. The air is compressed and distributed through underground pipes by machines of 2,000 horse power. Over 20,000 horse-power is provided, and 400,000 cubic meters of compressed air can be turned out per day. The supply is at present chiefly used for electric light production.

Accumulation of Electricity by Gravity.

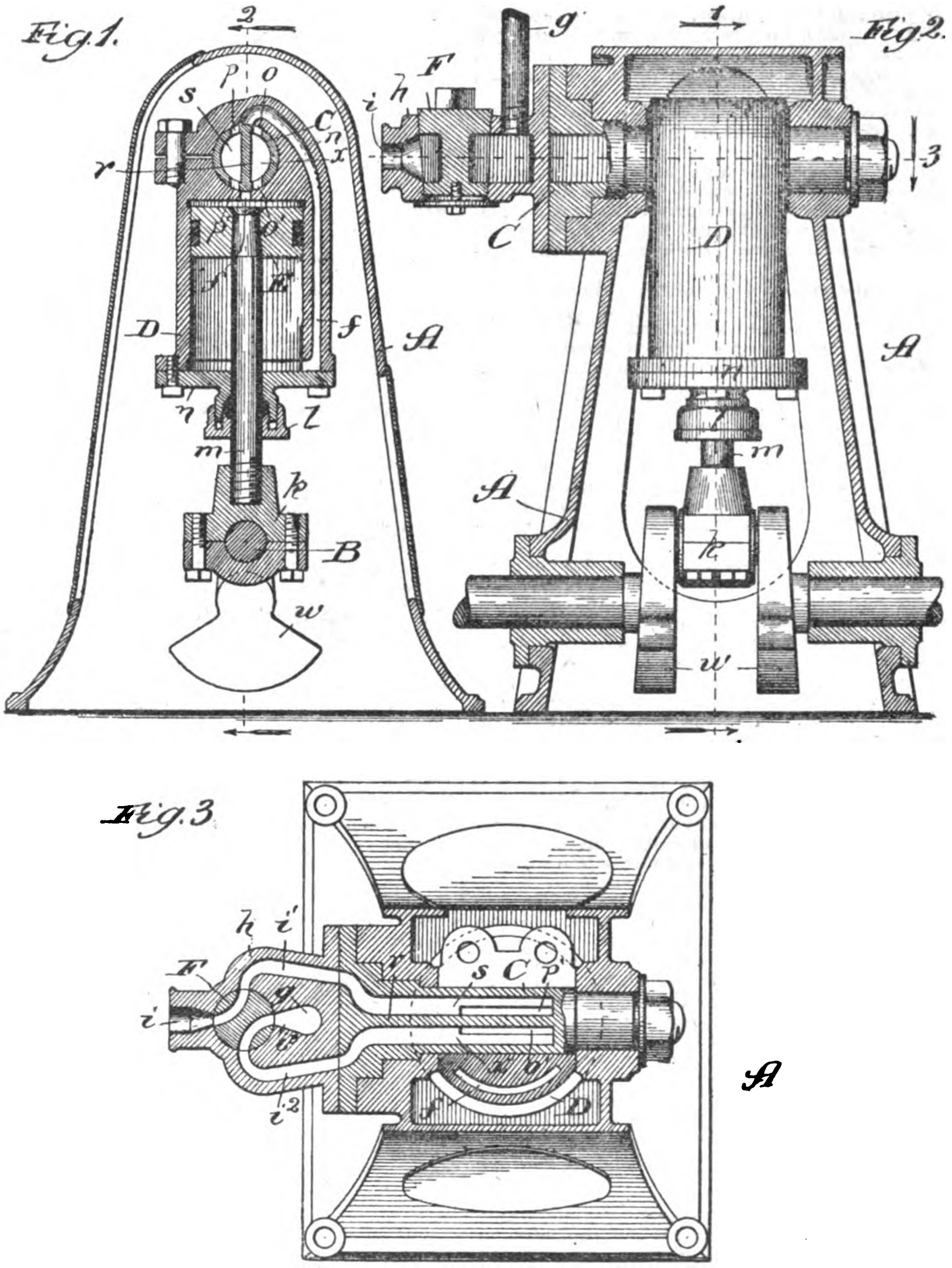
It is reported that the Northern Railway Co. of France will make experiments with an electric locomotive on their line from Paris to St. Denis. On this line the trip in one direction being all down grade, does not require the use of a locomotive. The experiments are being made with a view of being able to keep the motors in motion on the down grade and restore to the batteries a portion of the power generated by the gravity of the train, thus saving a great amount of energy which under ordinary circumstances would be entirely lost.

A NOVEL OSCILLATING STEAM-ENGINE.

William Thomas, of Ovington, Ill., was granted (December 1, 1891) a patent on a novel oscillating engine, herewith shown:

In the accompanying cuts, Fig. 1 is a sectional view, taken on the line 1 1 of Fig. 2 and regarded in the direction indicated by the arrows, of the single form of my improved oscillating reversible valveless steam engine. Fig. 2 is a similar view of the same, the section being taken at the line 2 2 on Fig. 1 and regarded in the direction indicated by the arrows, with the cylinder represented in elevation. Fig. 3 is a sectional plan view of the same, taken on the line 3 3 of Fig. 2 and regarded in the direction indicated by the arrows.

The principle involved in this engine is that of having the steam-cylinder or any desired number of such cylinders, each provided with two steam-passages leading, respectively, to opposite sides of the piston, connected at its piston-rod with a crank on the shaft to be driven and suspended to oscillate on a stationary hollow pin, forming the steam-chest, divided by a diaphragm longitudinally into two chambers, each provided with two ports, caused by the oscillations of the cylinder to coincide simultaneously in pairs with the said steam-passages, whereby the steam enters each cylinder alternately against and exhausts alternately from opposite sides of the piston from ports caused to open into the cylinder by its oscillating movements.



A NOVEL OSCILLATING STEAM ENGINE.

A, Figs. 1 to 3. is the supporting frame, having journaled in suitable bearings near its base a crank-shaft B. In the upper portion of the frame, extending parallel with the crank-shaft, is a rigid hollow pin C, divided longitudinally by a diaphragm r into two chambers s and x, either of which affords the steam-chamber, while the other is for the exhaust, and at the opposite upper sides of the diaphragm are the ports p and o, while at its opposite lower sides are the ports p' and o'. D is a steam-cylinder having a thick upper head n, provided with a cylindrical transverse opening in which the pin C fits snugly. E is the piston, the rod m of which passes through the cylinder-head n', (where a suitable stuffing-box l is provided, as indicated,) and is connected by a yoke k with the crank on the shaft B, the crank also carrying a counter-weight w for the cylinder. At one end of the hollow pin C (the opposite end being closed) is a head h, having at its outer extremity a steam-supply passage i, from near which extends branch passages i' and i^2, respectively, into the chambers s and x, and g is the exhaust-pipe leading transversely from near the center of the head h, where a short passage i^3 branches from it into a chamber containing a four-way throttle F. A steam-duct f leads from the cylindrical opening in the cylinder-head n, housing the hollow pin C, and from a point above the diaphragm r down through the wall of the cylinder D into the latter below the limit of the downstroke of the piston E. A vertically-short duct f' extends from below the pin C into the cylinder D above the piston therein.

The operation is as follows: With the four-way throttle F turned to the position most clearly represented in Fig. 3, steam is entering the steam-chest chamber s, the duct f' then eventually (when the crank is moved beyond the center) coinciding with the port p', the ports p and o' being closed by the head n, and the passage f coinciding with the port o when the duct f' coincides with the port p'. Then the steam from the chamber s will enter the cylinder D against the upper side of the piston therein, driving the shaft B, and the downward stroke of the piston will force any steam previously admitted behind it out of the cylinder through the passage f into the exhaust-chamber x, whence it will escape through the passage i^2 and throttle F out of the pipe g. The movement thus described throws the crank-shaft half-way around beyond a dead-center, and the completion of its throw oscillates the cylinder D back, bringing the duct f' to the port o', leading into the exhaust-chamber x, the port p leading from the steam-chamber to the passage f and effecting closure of the ports o and p', whereby the steam enters below the piston and that above it is exhausted. Thus the oscillations of the cylinder D continue and rotate the crank shaft.

Clyde Shipbuilding in 1891.

The returns of shipbuilding on the Clyde during the year 1891 show that while the shipbuilding trade has been fairly brisk throughout the year, the total value of the output shows a decrease. The estimated total value is returned at £8,000,000 as compared with £9,400,000 for the year 1890. The cause of this large falling off in value is attributed to the large increase in sailing tonnage, fully 40,000 tons, and the large decline in steam tonnage, fully 82,000 tons; and also to the lower value paid for material. Wages, however, have been about as high as in the year 1890. War vessels launched on the Clyde during the past year present an aggregate tonnage of 15,267, showing an increase of 6,016 tons, and of these, four swift cruisers for the British Government aggregated 14,400 tons. There was also a cruiser for the Canadian Government, for the St. Lawrence; and another for the Egytian Government, for Customs protective purposes. The total number of vessels launched on the Clyde, was 373, of 322,010 tons.—[Iron and Steel Trades Journal, London.

A SET OF FINE TOOLS.

A True Story.

BY WM. HARRISON.

[Let not the reader whose taste does not run to that which diverts as well as instructs the mind, and who shuns fiction as unprofitable stuff, think that he will violate his custom by perusing Mr. Harrison's paper. It is essentially true, and those who skip it will miss a narrative that substantiates the saying that "Truth is stranger than fiction."—Ed.]

Charles C. Adams was in many respects a very remarkable and a very unfortunate young man. He was entirely exemplary in his habits, and was industrious to a fault. He was a first-class machinist and mechanic, and was a lecturer in a scientific school. He was known as an original genius everywhere he went.

In these respects he was fortunate. But he was an inventor, and had kept himself and his family in poverty, trying to make fortunes out of the ideas he evolved from his prolific brain and got patented. He was about thirty years old, and had more than a hundred letters-patent bulging out of the drawers of his dresser. He could not learn from experience and quit putting money in them, but kept right on. The trouble with him was, not that he persisted, but that he had so much confidence in some devices utterly impracticable. If he had stuck to one really good thing, he would have deserved commendation, but, although one of the brightest minds in the West, he could not see what was and what was not commercially valuable.

His friends deplored his weakness and endeavored to gently direct him aright, but it was to no purpose. He was grateful for their good offices, but did not reform.

But his fertility did not exhaust, and at last he brought forth an invention that his acquaintances admitted was a wonder. It would be betraying confidence and serve no good purpose to tell what it was, further than the general statement that it was a machine that performed what had not before been performed by mechanism or by hand, in an extensive line of manufacturing business.

But Mr. Adams found himself in the saddest condition he had ever known when this patent was granted. He had worked himself sick, and was reduced to the most distressing penury. He had his aged father and mother and an invalid sister to support. He often reproached himself for not abandoning his inventing and inventions to devote his means to the addition of comforts to those dependent upon him, and now he felt his mistake more keenly than ever. Still, he could no longer doubt, and was assured by men of sound judgment that he had a machine worth a fortune, if properly handled. But he needed a little money to push it. Without some he could not even sell it for what his patent cost. With a small amount he could have a larger machine built, and when the manufacturers, whose business it concerned, saw it in actual operation, he certainly could get something for it. But no one he approached would advance him any funds, and none of his friends at the school had the necessary means.

If he had not been ill he could soon earn the money, but he was confined to the house, and had been for weeks. True, he was improving, and could now write lectures for some of the students to read, but this brought him very little. There was not sufficient in the house to keep them from hunger.

It was Saturday night. His old mother had spread the table and placed thereon a crust of bread, hardly fit to eat and not large enough to satisfy even a sick man. They all urged him to partake, but he sat at the window gazing into the forlorn street, an expression of acute pain, of despair and desperation fixed upon his square, smooth face. He was proud. He had refrained from asking assistance a second time of his friends, hoping that it might not be necessary. But there were his parents and sister actually starving, and himself sick.

Charles C. Adams bowed his head and groaned aloud. Then he straightened himself up, reached his coat, put it on, and went out into the cold night air—to beg. He might have secured means by sending to any one of a dozen he knew of, but he was crazed by his poignant remorse and sorrow and scarcely realized what he did.

The first person he met was a well-dressed man of about his own age, who was looking sharply at the numbers on the row of small houses. Charles could scarcely summon courage to make his humiliating request. But, as the man passed him, he stammered out: "Pardon me, sir, but, but—were you looking for some particular place?" His courage had failed him, even after getting started. The man glanced searchingly at him and said: "Yes, sir. I am looking for the residence of Charles C. Adams." Charles staggered in surprise and a ray of hope glimmered forth. He took the gentleman into the house. The latter asked for a private interview, and the rest of the family retired to the kitchen, notwithstanding the gentleman's protest.

The card he handed the inventor bore the name, John W. Ellis. Mr. Ellis was a cultivated man, very neatly attired. He explained that he was looking for some mechanic to do a job of fine work. He wanted one on whose honor he could rely as well as his skill, for he was the agent of a number of individuals who had control of the drawings of an invention that would be considered the most remarkable of the age and must be worth millions. They wanted some tools made with which to work on a model. There must be absolute secrecy, at any price. Money was no object. They wanted the instruments at once. He could make them at home, in his experimenting room. No exertion was needed, and the doctor could not object to the light work it would require for skill only was necessary.

"Consider, Mr. Adams," said Mr. Ellis, "that the parties getting up this device are confident that it is worth more than the patents of Alex. Graham Bell, and you will readily understand why we are so careful, even in getting the tools made with which the model is to be built. Now, you are, if you do this for me, to take the drawings, which I will send you Monday, and make the tools. They will be fully explanatory. You are to promise me not to speak of this interview nor of the drawings or tools to any one, no matter what you may think—not even to me, for if you begin talking about it you may not be able to break off. It may take you a week—not longer. If you wish to see me at any time you have only to call at the —— House (the best hotel in that town) or at the Young Men's Christian Association. What do you say? Shall I have to look further?

Charley Adams was entranced. Here was manna from the skies, right before him. Should he let the young man look further when they were starving at home? He would deserve to be hung if he did—and such a nice fellow, too. Undoubtedly if the invention became successful they might employ him regularly. But, if he got some money for his work, which the young man said could be done at home, his own invention could perhaps be pushed.

These were the thoughts that shot through the inventor's brain, in five seconds, while clearing his throat to say: "Certainly, sir. I would be very grateful for such employment. Leave me your drawings, and I promise you that I shall never lisp a word to any living person."

"That assurance is sufficient," said Mr. Ellis, as he took out a pocket book. He drew forth five bills, and laid them on Mr. Adam's knee, saying, as he did so: "You shall have as much more when they are finished."

"Thanks, thanks, my dear sir. I hardly feel like taking this before any work is done," replied Charley.

"That is all right, it binds the agreement," returned Mr. Ellis, rising and leaving, but first repeating that the drawings would be sent on Monday.

"Mother! Father! Alice!" cried Charley, in childish joy, running into the kitchen and shaking the five bills in the haggard, eager faces of his parents and sister. "I have got five dollars. Just think what we will have. Give me the basket. The grocery is still open."

While his mother hastened for the basket, the old father and thin, wan sister Alice came close to Charley to look at the first money they had seen for three months.

"What!" said Alice. "Five dollars, Charley? He must have made an awful mistake. What shall we do? Each one of these is a hundred-dollar bill!"

They all stood dumfoundered, for it was so.

[To be continued.]

Notice of Removal.

The General Offices of the N. Y., C. & St. L. R. R. Co., formerly occupying the Hoyt Block, corner of Bank and St. Clair Sts., will on and after Monday, January 25th, 1892, occupying the fourth and fifth floors of the Hickox Block, northwest corner of Euclid Ave. and Erie St. Temporary entrance, north end of building on Erie St.

THE ELECTRIC LIGHTER.

One of the most delightful of the minor accessories that electricity furnishes to the household is the newly-invented "Electric Lighter." This is a beautiful ornament for the parlor, dining-room or chamber, always instantly responsive to a call for light and of valuable service in other ways to the family.

It is operated by pressing the little button seen at the top of the centre rod, when the light instantly appears at the opening under the ornament upon the upper band. It is made of highly polished nickel plate, is but six inches high and occupies only six square inches on the table or mantel. Its construction is so simple it can be readily taken to pieces and as easily readjusted to working order. It needs no wires or connections, the current of electricity being generated by chemical action within the cylinder. It is perfectly safe, always secure, and a child can operate it.

The material used in the battery is sold by every druggist, and a charge costing but ten cents is sufficient to keep it in constant service for thirty to sixty days. With usual care it will last a lifetime, and if it should become disabled by an unfortunate tumble, any damaged part can be replaced at trifling expense. Its construction is so handsome and ornamental it will readily find its place among the bric-a brac of the choicest apartments and is easily portable from room to room.

It will be found a most desirable companion for the merchant or lawyer in his office, the professional man in his study, the student in his lodgings, as well as the housewife, and its neatness and quick responsiveness will recommend it to all.

It is manufactured and sold by the Barr Electric Manufacturing Co., at Nos. 17 and 19 Broadway, New York. The price is $5, a veritable trifle when its beauty and service are considered.

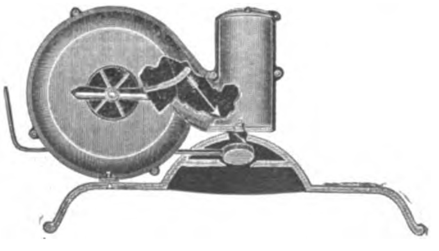
Though originally designed simply for a lighter, it has been found practicable to add several useful accessories. A medical coil with hand electrodes can be readily attached, by which either gentle or sharp electric shocks can be given to a member of the family afflicted with nervous affections, rheumatism, neuralgia, lumbago, sciatica, headache, etc. This attachment can also be connected by wire to the doors and windows of the house, thus providing the homestead with a complete and perfectly reliable electric burglar alarm, or if in a city, it can be connected with a street wire to the nearest police station. The price of the medical coil is $3.50.

Another adjunct is the call bell, which is also easily adjustable and operated by pushing down the central rod, as in a dinner table or call bell. The price of this with 100 feet of wire, is but $1.25.

The merits of this novel invention cannot properly be described in a newspaper article. It needs to be seen to be appreciated. Its beauty, quick service and simplicity of construction make it an instant favorite.

Already several of our large jobbing houses have added it to their notion stock, and as soon as it reaches the retailer, it will prove a "quick seller." For a novel and inexpensive present from "Pa to Ma," or to a bachelor friend, it has no superior in the market. Retailers who carry a notion department should send to the company for circulars and prices. We are convinced the Electric Lighter will find ready and constantly increasing sale in every section of the country.—[Dry Goods Chronicle.

BLAST FOR CHAPMAN'S FORGE.



Herewith is given an illustration of the improved direct blast-fan used on all Chapman portable forges (see advertisement elsewhere). This fan is located very close to its work, having the shortest and most direct air passage. A large ash pit is provided. An air space is also provided under the fire plate and tuyeres to prevent burning, and their forges are gaining the hearty approval of many practical men wherever sold.

WITH A
WALTHAM
OR
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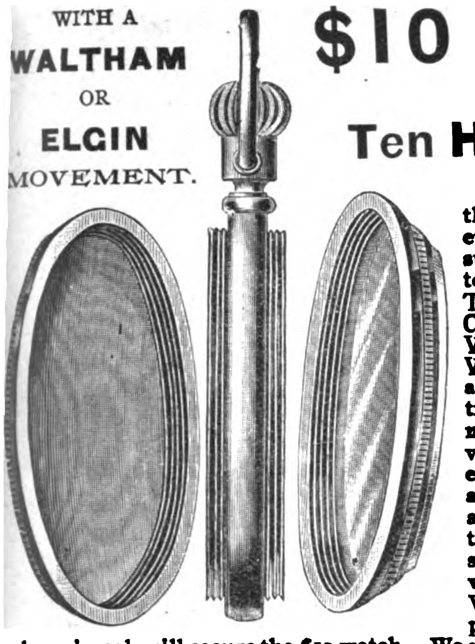

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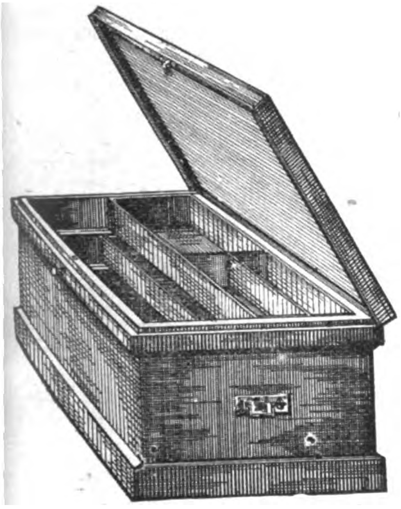

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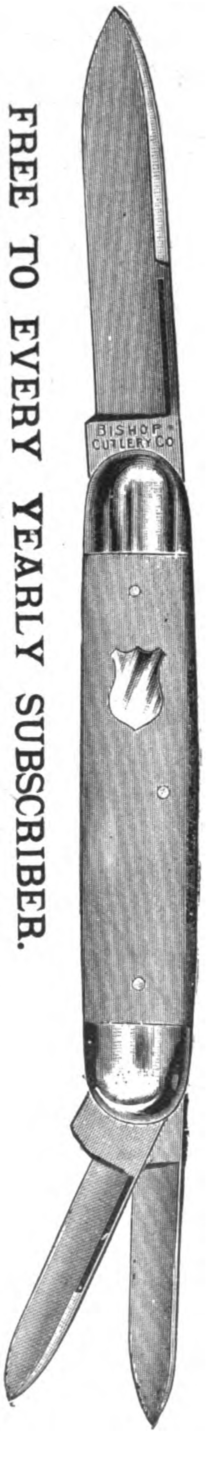

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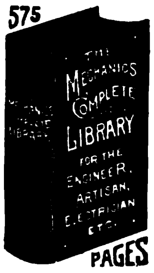
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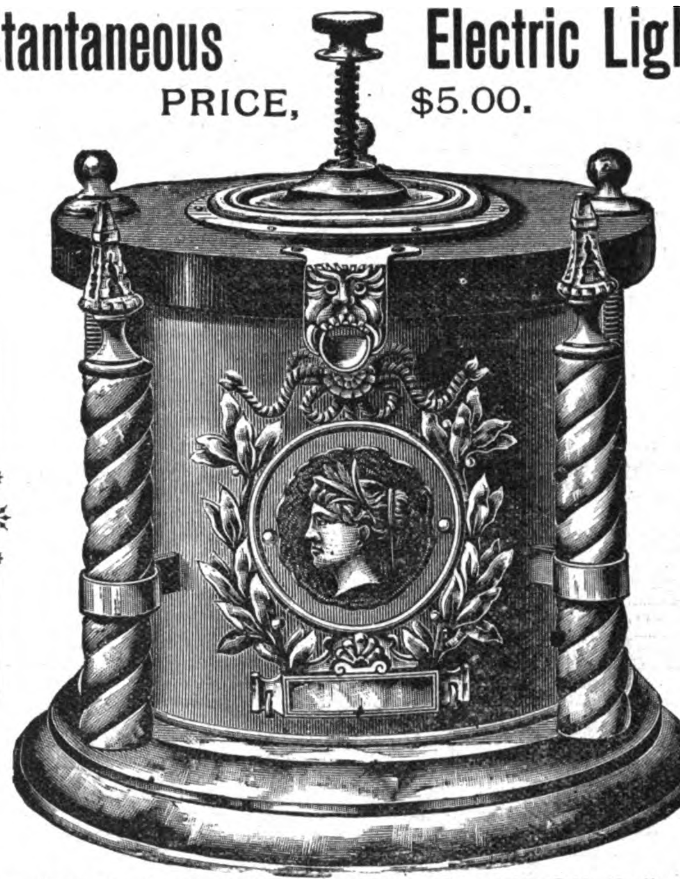

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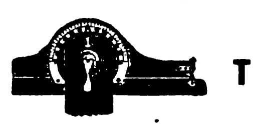

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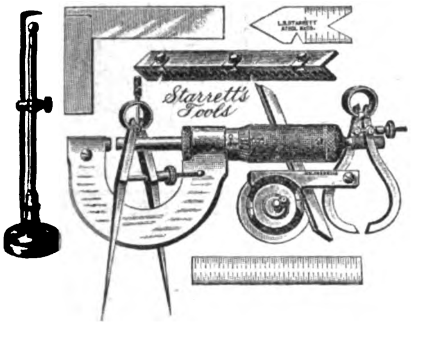

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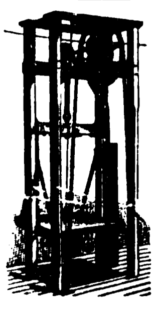

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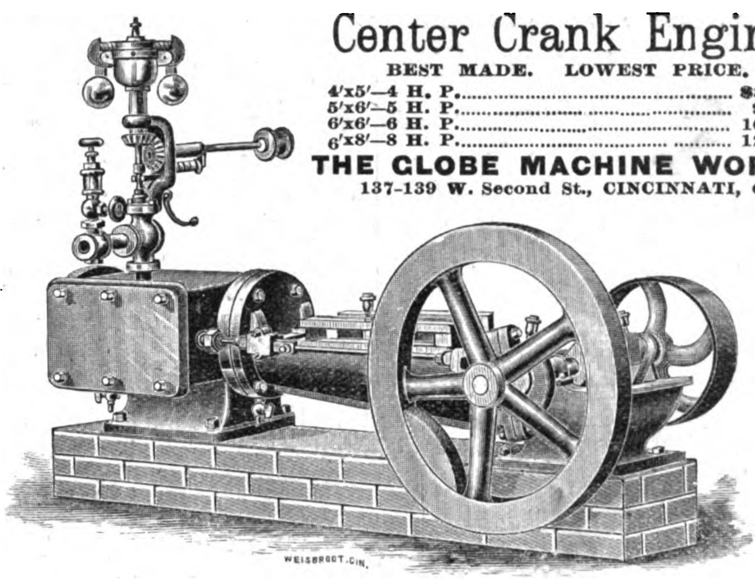
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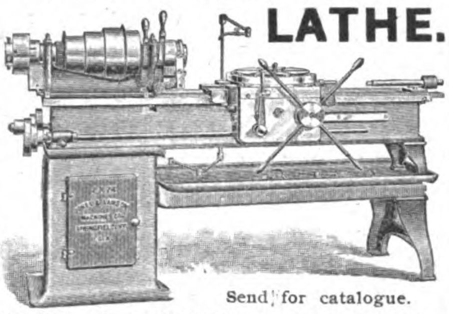

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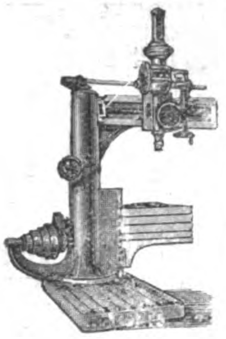

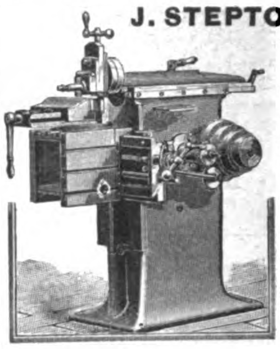

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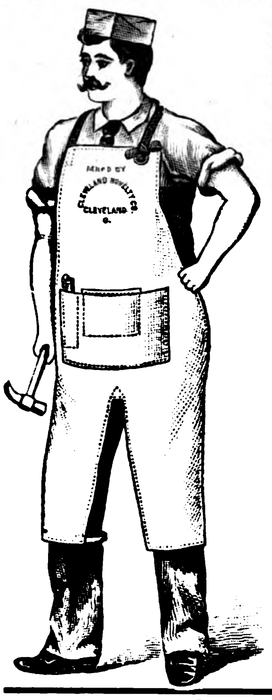

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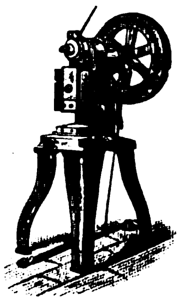

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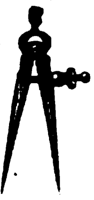

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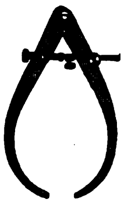

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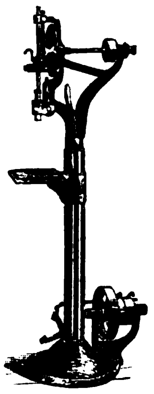

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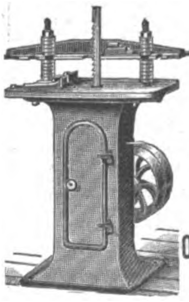

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VOL. X.—NO. 4. CLEVELAND, O., FEBRUARY 15, 1892.

PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS.
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THE NEW YORK CENTRAL FLYER.

Nat. Sawyer, of New York, furnishes the *Locomotive Engineers' Monthly Journal* with the following description of the engine that made the fast run (of about 97 miles per hour, we think) on the New York Central road. The cut was loaned us by Mr. Hays, editor of the *Journal*:

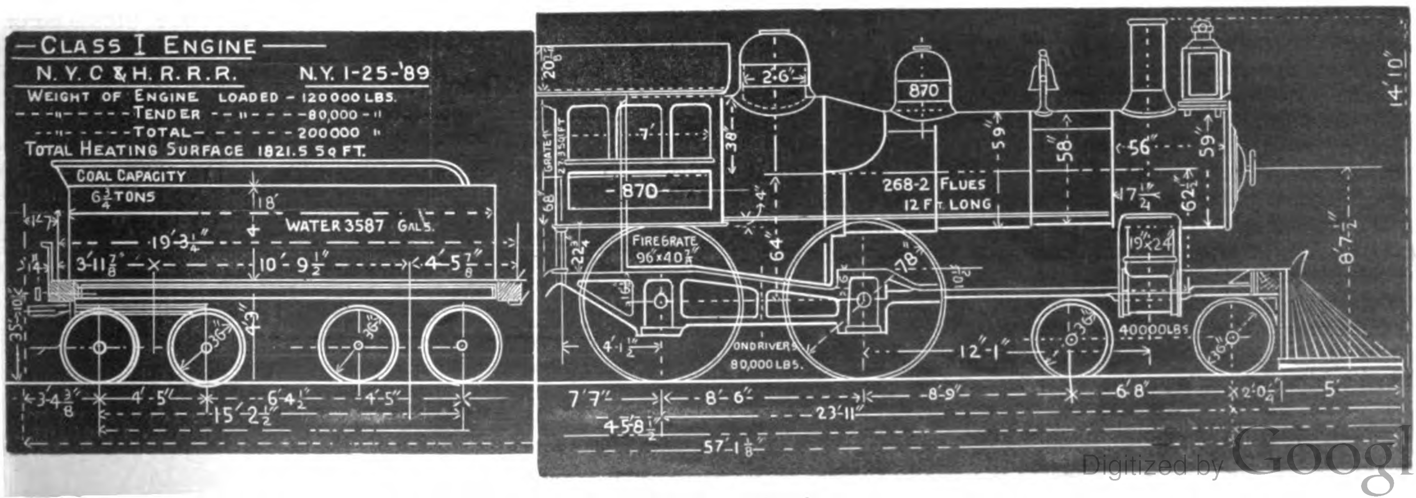
Engine No. 870, a diagram of which appears in connection herewith, is the engine that hauled the record-breaking special train from New York to Albany, September 14, 1891, and at present in service hauling the "Empire State Express." It was designed by Mr. Wm. Buchanan, S. M. P. & R. S., for heavy trains and fast passenger service, and was one of a number built at the Schenectady Locomotive Works.

As originally designed, it was fitted with 5 feet 10" driving wheels. After two years' hauling the "Chicago Limited," showing a very efficient performance, Mr. Buchanan, who has always been one of the foremost peace-makers in improving railroad equipment, anticipating the popular demand for faster passenger service, had No. 870 sent to the West Albany shops, where the 70" wheels were replaced by others eight inches larger in diameter, and the attendant alterations made. * * * *

General Dimensions. — Cylinders, 19x24; steam ports, 18x1¼; exhaust, 18x2¾; bridges, 1⅛; throw of eccentric, 5¼; valve travel, 5½; crank pin, main journal, 5½x5½; side rod, 4½x3½; driving journals, 8½x10½; engine truck 6x10; tender, 4½x8; outside lap of valve, 1; inside, 0; boiler material, steel, ½ thickness; fire box, inside, 96x40⅞; depth in front, 70¼; heating surface, flues—1,670.7 square feet; fire box, 1508—total, 1,821.5; grate surface, 27.5; diameter of stack, 15¾; exhaust nozzles, 3⅜; radius of link, 66".

These engines have great tractive power, and the weight on drivers allow of a corresponding adhesion. The heating and grate surfaces provided for—a total of 1,821.5 square feet of heating surface to 27.3 square feet of grate surface—afford favorable opportunities for rapid steam generation and economical coal consumption. That these conditions are being developed every day are undeniable facts, the service and record of their performances as well as the testimony of the traveling public on the N. Y. C. fully attesting this. The practice of scooping water from troughs laid in the center of tracks was first introduced on the Hudson River Division of the New York Central, in 1870, since which time all through passenger engines have been fitted with this water scoop; most of regular trains make a continuous run of 143 miles without a stop, slowing up only to pick up water.

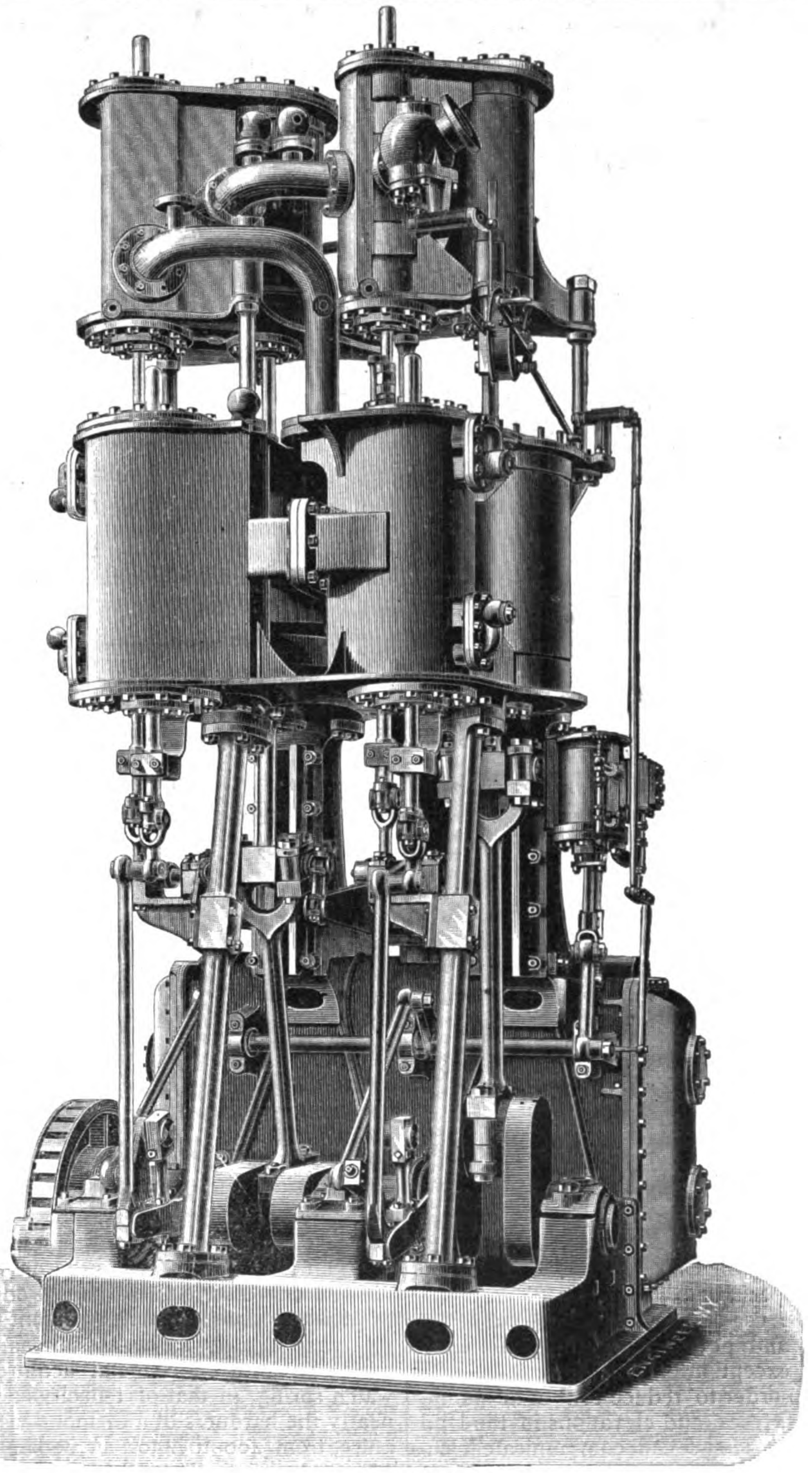
The drivers of this giant iron steed, "Archie" Buchanan and "Billy" Kirk, are two of the most cool, reliable, and fearless engineers on the Central system, and, barring accidents, the passengers entrusted to their charge arrive at Buffalo in safety and *on time*.



THE NEW YORK CENTRAL FLYER.

QUADRUPLE ENGINES.

On our first page is an illustration of the engines of the New York & Western Railway Co.'s tug boat Dorothy, built by the Newport News Dry Dock & Shipbuilding Co., from specifications and directions of Horace See, naval architect, New York. The engine occupies less space than the two-crank double-compound of the same power, the coal endurance being much greater. The cylinders are 9¾", 13½", 18¾", and 26" x 22" stroke, using steam at 180 pounds from a boiler 9½x10½ feet long, built by the Lake Erie Boiler Works. The lower cylinders are bolted together, and supported on one side by two columns cast on the condenser, and on the other two by wrought iron columns fastened to the bed plate, the cast columns forming the guides. This description and cut are from the *Marine Review*.



QUADRUPLE ENGINES.

A SEA TELEGRAPH.

Thomas A. Edison has perfected and patented another wonderful electrical invention. It is one that is intended not only to further the interests of commerce, but to protect human life at sea. It is, in substance, a system by which telegraphic communication can be carried on between ships at sea, between ships and the shore and between distant points on land.

The most remakable part of it all is that this intercommunication can be maintained absolutely without the use of wires or cables, the principle being that of induction, which was recently brought into prominence by Mr. Fesla.

Here is one of the ways in which the invention will work: Suppose all the ships that sail the seas are fitted with the proper apparatus. An ocean greyhound—the *City of Paris*, say—breaks her shaft, and there are fears that she may sink if assistance cannot be summoned quickly. Not a sail is in sight, nor a sign of smoke on the horizon. An operator skilled in the transmission of Morse characters manipulates a key located, for instance, in the chart-room. Away down below the horizon is another ship, so far distant that not even her topmasts are visible. The Morse signals are transmitted to the other ship and answered. The disabled ship gives her position, and the other speeds to her aid.

The other ship might be a small bark or brig proceeding under sail, and incapable of rendering aid. In such a case the bark or brig would work her signals, which would be caught up by any ship within a radius of say 30 miles. Then they might reach another sailing ship, also too small and too far away to give the assistance required, but she in turn would begin signaling, covering another radius of 30 miles The signals might pass along to half a dozen ships before they reached one large enough to aid so big a vessel as the *City of Paris*. When they did reach one, however, she would reply that she would go to the disabled vessel's assistance. The word of cheer would be passed back from ship to ship until it reached the *City of Paris* again.

Suppose the rescuing ship to be the *Majestic*, bound westward, the *Paris* having been on her way from New York to Liverpool. She takes off the passengers and crew of the wrecked vessel, and proceeds on her way to New York, keeping her operator busy making signals or calls. A few hours after the rescue an answer comes. It is from the *Teutonic*, bound for Liverpool. A message flies from one ship to the other, they alter their courses, quickly come into sight, and are in good time within a cable length of each other. The *Teutonic* takes the *City of Paris* people from the *Majestic*, and carries them on towards Liverpool.

The original signals sent from the *City of Paris* may have first reached a ship far to the north of her; those of the second ship may have gone to one well to the eastward; the ones repeated from her may have reached another to the southward and have been passed on still further south until the rescuing ship was reached. All this would be done within a few minutes, so that surely within half an hour of the disaster a rescuing ship would be found.

Suppose a dense fog prevailed as the *Majestic* was nearing our Atlantic coast. She may have become a trifle uncertain as to her bearings. Should she come within 30 miles of land, however, she would be able to communicate with people on the shore, and find exactly where she was.

Collisions would be impossible. Every ship within a radius of 30 miles would be able to tell each other who, what and where they were. Ships out of sight of each other at sea could speak and ask to be reported. A passenger carried out to sea by a Transatlantic steamer by accident could pass word to shore, that his friends might be notified of his safety. There are innumerable other examples that might be used to explain the way the invention will work.

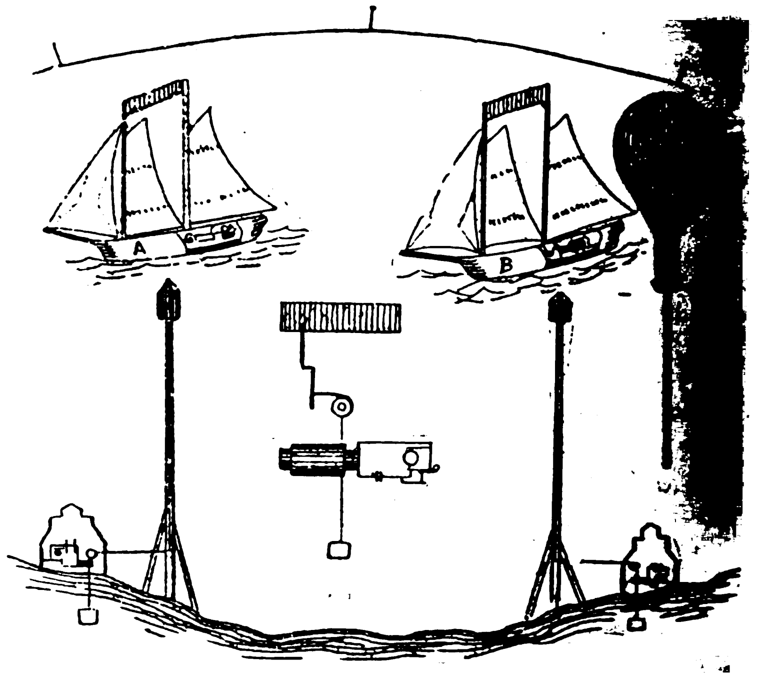
The principle involved is that of induction. Naturally, only those who have given some little study to electricity will understand clearly just how and why those results are obtained.

In his specifications, filed at the patent office in Washington, Mr. Edison says:

"I have discovered that if sufficient elevation be obtained to overcome the curvature of the earth's surface and to reduce to the minimum the earth's absorption, electric telegraphing or signaling between distant points can be carried on by induction without the use of wires connecting such distant points. This discovery is especially applicable to telegraphing across bodies of water, thus avoiding the use of submarine cables, or for communicating between vessels at sea and points on land, but it being necessary, however, on land (with the exception of communication over open prairie) to increase the elevation in order to reduce to the minimum the induction-absorbing effects of houses, trees and elevations in the land itself. At sea, from an elevation of 100 feet, I can communicate electricity a great distance, and since this elevation, or one sufficiently high, can be had by utilizing the masts of ships, signals can be sent and received between ships separated a considerable distance, and by repeating the signals from ship to ship communication can be established between points any distance apart or across the largest seas, and even oceans.

"The collision of ships in fogs can be prevented by this character of signaling, by the use of which, also, the safety of a ship in approaching a dangerous coast in foggy weather can be assured. In communicating between points on land, poles of great height can be used, or captive balloons. At these elevated points, whether upon the masts of ships, upon poles or balloons, condensing surfaces of metal or other conductor of electricity are located. Each condensing surface is connected with earth by an electrical conducting wire."

In the accompanying taken from Cleveland *World*, two vessels are shown with condensing surfaces affixed between the masts. In heavy weather these surfaces can be flown from one mast in the form of a streamer. They may be made of canvas covered with flexible sheet metal or metallic foil, carefully secured. From the condensing surface on each vessel a wire extends to the hull and through an induction coil and revolving circuit breaker and key to a metal plate on the bottom of the ship, by which connection is had with the ground through the water. The diagram in the middle of the cut shows the course of the circuit from the key, through a primary battery to the induction coil, and thence to the condenser. Electrostatic impulses are produced in the condenser, which pass by induction through the air to the condenser on the other ship, which is located at a similar elevation. They pass thence to an electro-motograph telephone receiver placed in the circuit between the condenser and the ground plate. The Morse characters are produced by slight vibrations of the diaphragm, and are made audible by the electro-motograph. The air is full of molecules, which act as insulators. It is the passage of the current through these molecules which produces the induction, which means the transmission, quicker than thought, of the current from one particle to another. The body of the air forms the dielectric or insulation between the condensers on the two vessels, the circuit being completed by the passage of the current through the water or earth.



By sending up the captive balloons from ships the distance through which signals can be sent can be vastly increased, the object being to overcome the curvature of the surface of the earth.

The balloon in the diagram is fitted with a condenser on top, from which a wire passes through the cable confining the balloon to the earth. The uprights shown in the cuts are on opposite sides of a wide body of water. The condensers are on top of the poles, with wires running down to offices at their base, where connection is had with the ground.

If a balloon in New York should be sent up to a great height, equipped with a condenser, and held to the earth by a rope cable in which there was a strand of wire, and another, similarly equipped, should be sent up from London, a circuit would be formed through earth and air, without the aid of wires for transmission, through which messages could be flashed at greater speed than has ever been attained by any other sytem. All that is necessary to do is to locate the condensers at a sufficient height to overcome the curvature of the earth's surface. This is similar in many respects to the train telegraph system invented by Mr. Edison, and now in use on the Lehigh Valley railroad, by which messages are transmitted between moving trains and stations, and from one train to another. The new invention has boundless possibilities. All that it can accomplish can as yet only be conjectured by Mr. Edison, who has unlimited faith in its efficacy.

Peculiarities in the Treatment of Iron and Steel.

The peculiarities developed in the various processes of metallurgy are no more strikingly exhibited than in the treatment of iron and steel. Thus, the addition of carbon to pure iron results in the production of steel, while the addition of a hydrocarbon produces effects so marked that steel itself becomes modified to such an extent that its properties are not recognizable; steel may in this way be as soft as pure iron. On adding hydrogen, in varying quantity, the metal acquires the quality of resilience, as in the watch spring, or that of tenacity as in the knife or razor, or may be given nearly the hardness of a diamond, as in a file. With steel at a low temperature, from 400 to 450° F., edge tools are produced, the color in the yellow shades; from 500° to 525°, various sorts of springs are produced, color blue; while by heating iron to whiteness and plunging it into water, which is mainly composed of hydrogen, files are produced or forms even harder.

THE Phœnix Iron Works Co., organized last September, with Frank Patterson, President, Ed. Leighton, Vice-President and Chas. Hathaway, Secretary and Treasurer, is beginning the year remarkably well. The general manager, Wm. Russell, is a young man with the energy and experience to make a success of any manufacturing business. The Phœnix Co. is continuing the manufacture of the same line of goods as before.

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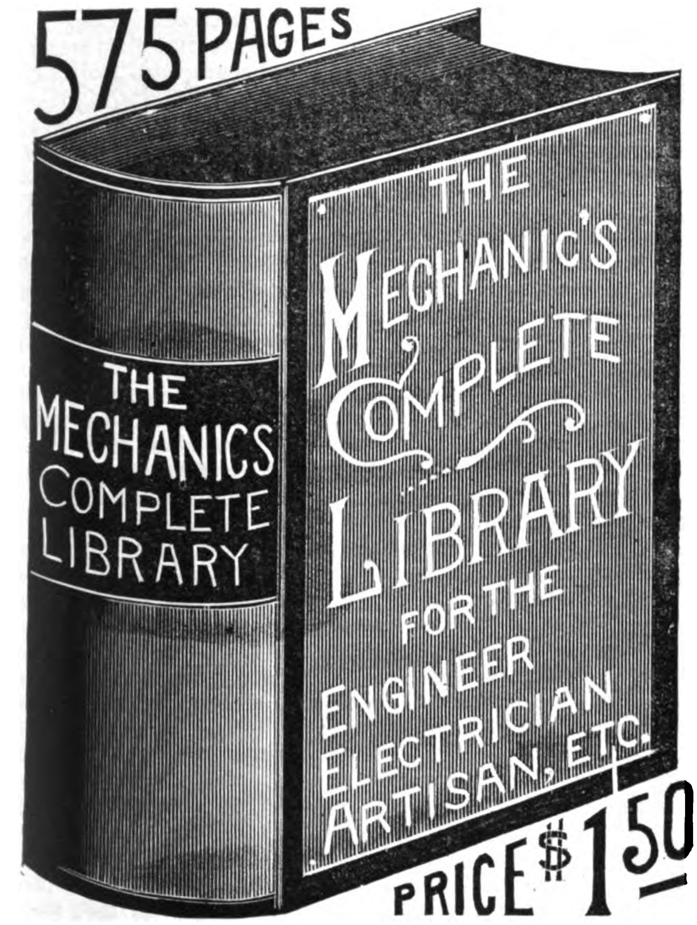
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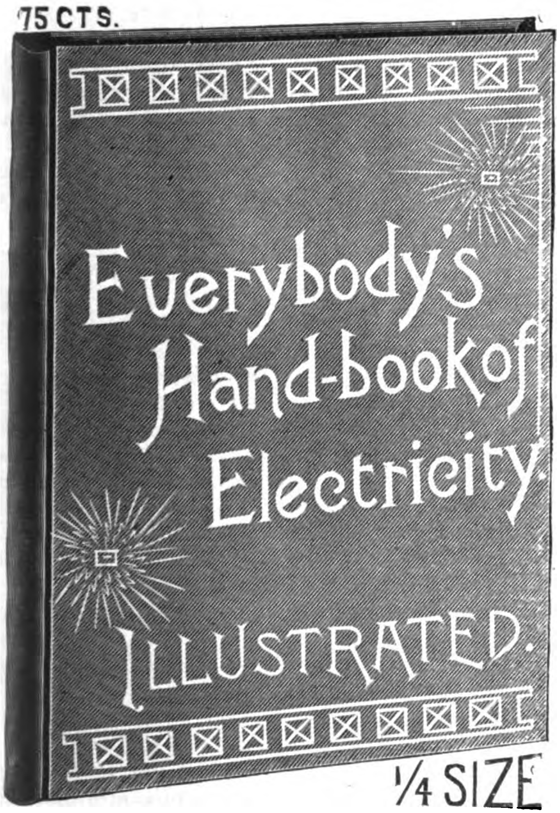

A word about our paper seems in order right here. THE SCIENTIFIC MACHINIST is published on the 1st and 15th of every month, and is $1.50 per year, in advance. We consider it the cheapest mechanical journal published, judged either by the amount or quality of reading matter. The work of the best mechanical writers will be presented in every issue. What more can any journal give its readers? Examine it and form your own opinion.

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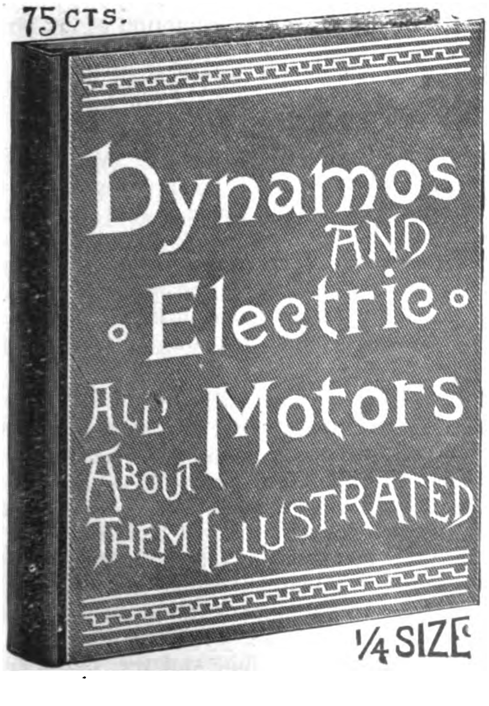

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SEE PARTIAL LIST OF CONTENTS ON PAGE 14.

DYNAMOS AND MOTORS and EVERYBODY'S HAND-BOOK OF ELECTRICITY Are by Edward Trevert, a well known and reliable author. They have been given many flattering notices by the press and are splendid volumes. The cheapest editions, in cloth, were never sold for less than 50cts. a copy. The editions we have bought are **extra fine paper and binding, worth 75 cts. each, and cannot be bought for 50 cts.**

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THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience or experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

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CLEVELAND, OHIO, FEBRUARY 15, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

FRATERNAL INSURANCE.

It is not infrequent that mechanics are solicited to join some society having insurance as an adjunct. Most men in this enlightened age, who have not a considerable property to leave to their families in the event of their death, are at least desirous of insuring their lives in order to provide after their demise what they had not been able to accumulate before. This is humane and is civilization. It is a fact that a reasonable amount of insurance can be bought by most mechanics, but they put it off because it seems too much of a burden "just now," and perhaps because some concerns have given up the ghost. The latter is no reason why they should remain out, for they have a duty to perform for the protection of their family, even if some risk is taken.

It is to be deplored that fraternal insurance has not turned out better, and that fraternal orders do not show up better, but nevertheless, fraternal insurance is, most emphatically, a good thing, and no man with a family should be without it, unless he is able to buy it in an "old line" company. Machinists, engineers and all other mechanics should carry insurance. There are some of the newer orders, organized for insurance mainly, that have taken example from the experience of older ones and avoided their weak points. These at least, with conscientious management, are safe for a good many years.

One of the best fraternal insurance societies in the country is that of the Fireman's Life Insurance Association, of Cleveland. If it were possible for organizations composed of men working for different concerns to adopt their plan, every man could get substantial insurance at a reasonable rate. On the death of a member, each surviving member pays $5. The advantage they have is that there is no clerical work, no dependence upon the option or honesty of members to pay, for every one must sign an order authorizing the City Treasurer to deduct $5 from his salary on the death of each and every member of the department who belongs to the Association. This machinery is not possessed by many organizations.

However, employes of railroad companies, large shops, etc., can get a good pointer from this, for there the conditions would be the same, and a society could be formed on that plan. But a three-thousand-dollar insurance policy does not cost a young or middle aged man so much, in a well organized fraternal society, that he can not easily carry it. It should be one of the first items on the list of necessary expenses.

WE are pleased to note that Mr. A. H. Kerkhoff has built a factory on the corner of Western avenue and Dayton street, Cincinnati, O., and gone into the business of manufacturing drill presses, under the firm name of A. H. Kerkhoff & Co.

Mr. Kerkhoff is well equipped to build up a large and successful business, for he has had much experience in manufacturing, especially in the line of drills. He is a Western man, but for a time was Superintendent of a shop in the East. Later he became General Manager for the Bickford Drill Co., of Cincinnati, O., which position he held for a number of years. Mr. Kerkhoff has many friends, and his reputation as a manufacturer is wide. Every one who has had business dealing with him will place great confidence in the Kerkhoff drill.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(325.) J. L. C., Sidney, O., writes: "A discussion came up this evening as to the comparative requirments, in knowledge of engineering and mechanics, of stationary, locomotive and marine engineers. An old locomotive engineer claimed that one who runs on the road needs as thorough a knowledge of engineering as any other kind of an engineer, and thought that the average man from the cab of a locomotive could easily take charge of and properly operate a Corliss engine plant or a triple-expansion marine. I am not very far along in the business, being only a stoker, but his opinion did not tally with my ideas exactly, and I write to ask your opinion of his statements." *A*—Without depreciating the skill required to run a locomotive engine properly—for it certainly requires a high order—it must be acknowledged, that the work tends to develop a knowledge of the locomotive only and gives but a narrow experience. The stationary engineer, perhaps, does not need to be as adept at getting an unusual amount of work out of his engine at times as his brother on the rail, but he has much more machinery in charge and is required to know about the accessories of a stationary steam engine, with which the man on the locomotive has nothing to do. He, therefore, is usually a more proficient engineer, and could much more readily run a locomotive than a locomotive engineer could run a stationary engine. It is certain that marine engineering demands a high grade of talent, large experience and fitness in many directions that are not considered requisite to the stationary or locomotive knight. We know of locomotive engineers who have assumed charge of important stationary plants and steamboats, and they are often possessed of wider knowledge, than is necessary for their work on the road, but we should place marine engineering first, stationary engineering second and locomotive engineering third, but with entire respect, as before stated, to the skill of each class.

(326.) C. G., Kansas City, Mo., writes: "I am running a slide valve, 50 H. P. engine and taking care of two hydraulic pumps, as well as looking after the shafting and machinery of the manufacturing establishment I work for. I have had four years experience, running an engine, and have given entire satisfaction to the three employers I have worked for. Now, I want you to advise me whether I should quit if my wages are not raised to $2 per day. I am getting only $1.50 and I have asked for $2." *A.*—A knowledge of the circumstances is always necessary to enable one to judge a question of proper compensation, but we believe that if you are giving satisfaction that you should have at least $2 per day. We could not, however, advise you to give up your job before procuring a better. If you can not induce your employers to pay you $2 per day, perhaps you can compromise a $1.75 per day. Then, you would do well to look around and find a better position as soon as possible. If you are attentive, sober, faithful and competent, you should earn more than $1.50 per day. If you strive to learn all about your engine, boiler and entire plant, ascertain how much coal is consumed per day and per H. P. developed and make it your business to discover the leakage in heat energy and do the largest amount of work at the smallest expense of fuel and wear and tear on the plant, you will surely find a plant before very long that will pay you higher wages, and from that you will get still higher by the same ladder.

(327.) W. W. C——n, Allentown, Pa., writes: "Would be pleased to have you give me, in 'Questions and Answers' column, some information on consumption of coal, what grate surface to a certain quantity of fuel, how it is found out, etc.?" *A.*—Area of grate required for externally-fired boilers is estimated in square feet per pound of coal. With moderate draught, .08 square feet per pound of coal, or a consumption of about 12 pounds of coal per square foot of grate surface per hour; with quick draught .06 square feet per pound of coal, or a consumption of 16 pounds of coal per square foot of grate surface per hour; with forced draught, .04 square feet per pound of coal, or a consumption of 25 pounds of coal per square foot of grate every hour. With marine engines the area of grate should not be less than .77 square feet per indicated horse-power, and the area of tube surface between the tube plates not less than 2.30 square feet per I. H. P.

(328.) J. G. G——l, Binghamton, N. Y., writes: "Would like to ask you for a brief, plain, every-day definition of 'good firing.' No algebra, or quadratics, or anything of that sort, please. It is for practical work, not theory, that I ask information." *A.*—Good firing means complete combustion, which is another way of expressing the consumption of just enough fuel to keep up the steam pressure required without waste. A bright flame all over the grate surface means good firing. Blue flames, dark spots and smoke show incomplete combustion, due to improper feeding of the fire or defective regulation of draught, that is, supposing fuel and furnace are free from defect.

(329.) Charles Bush, Dowagiac, Mich., writes: "There is in Pennsylvania, I do not know just where, what is said to be the largest stationary engine in the world. Will you kindly tell me through 'Questions and Answers' where it is, and something about it?" *A.*—One of the largest (if not the largest) stationary engines in the world is at the famous zinc mines at Friedensville, Pa. It is this you probably refer to. It is known as the 'President,' and there is probably no pumping engine in the world that can be compared with this monster. The number of gallons of water raised every minute is 17,500. The driving wheels are 35 feet in diameter, and weigh 40 tons each. The sweep rod is 40 feet long and the cylinder 110 inches in diameter with a 10-foot stroke.

(330.) "Reader," Cincinnati, O., writes: "Can you tell me why a planer table springs high in the middle? It is a 42" planer, bed 13 feet, table 9 feet, and stands on the fourth floor. Answer and oblige a reader." *A*—If it is set up properly, there must be some fault in the construction of the machine, or in its condition. It may be warped or a number of things may be the matter with it. Careful examination only can reveal the cause, and when the latter is known, most any good machinist can suggest a remedy.

(331.) Wm. Bryant & Co., M——d, S. Dak., writes: 1st. "We are running a horizontal engine in a plant of ours, in an out-of-the-way place, about 500 miles northwest from Minneapolis. The cylinder is 10"x12", and is slightly worn in the center. Can it be rebored, or trued up where it is, and if so, in what way, as it would cost considerable to move it?" 2nd. "Can you give us the address of some party publishing a work on saw repairing or saw straightening or saw hammering?" *A.*—1st. Nearly every machine shop has a portable boring bar for this purpose that they can place in any cylinder and do the work by hand. 2nd. Write to Henry Carey Baird & Co., Philadelphia, Pa.; Theo. Audel & Co., 91 Liberty street, N. Y., and John Wiley & Son, 53 E. 10th street, N. Y., for information concerning mechanical books. They know most about such matters. C. E. Grandy may have published his articles on hammering saws in book form. If so, you would do well to get a copy. Address him in care of *American Machinist*, 96 Fulton street, N. Y.

HINTS TO ENGINEERS.—VII.

BY EDWIN WOODWARD.

The first duty of an engineer before lighting the fires, is to lift the safety valve—for two reasons—first to see that it is in working order—and also to remove the partial vacuum before aluded to—which prevents the gauge cocks from indicating the true water level. The most convenient way of lifting the valve, is by means of a cord attached to the lever and lead over a pulley, and in easy reach. This is applicable to all safety-valves when steam is on, but it is effective only with pop valves to release the vacuum. Lifting the weight does not lift the valve, and relief must be obtained by opening the upper gauge cock, and after it has served its purpose it is desirable to leave it open till steam is raised that the air may also have a point of egress, then try the water, and if sufficient, the damper and draft opened and the fire kindled.

If the boiler and engine during working hours require the undivided attention of the engineer, he should take advantage of the leisure time between the building of fires while getting up steam, to clean and brighten up affairs in the room. Appearance requires that dust and cinders be kept from lodging on the boiler, connections, and front. This labor is greatly lessened and the life of the parts enhanced by covering as often as necessary with black varnish, which also makes a splendid guard against rust and dampness, that would otherwise attack exposed parts.

A first rate varnish is made by dissolving asphaltum pitch in boiling turpentine, to the consistency of paint, when cold. Apply with a brush. Also look often at packing of the engine—remove and renew if necessary. Polish and clean up the moving and difficult places about the engine, too, while they are at rest.

It is impossible to lay down an absolute and undeviating course for the fireman to pursue as regards the best methods of keeping the fire at a uniform volume. Certain aims are striven for, which, when attained, important results are guaranteed. The accomplishments of these ends are variously effected—one fireman will succeed, sometimes, in a course that would be absolutely disastrous with another—perhaps it is instinctive delicacy of manipulation that assures it, instinctive knowledge of conditions, by some called luck. However that may be, it undoubtedly will be proper to point out some of the common methods as practiced by successful firemen and leave the finer intricacies to be discovered and utilized by right of might.

Time was, in some parts of our country, when wood was used almost exclusively in making steam—and in many parts is still quite largely used. Technical writers as a class ignore this fact, presumably, for the reason that where wood is used it is of little value and all that can be burned is so much out of the way, forgetful of the fact that the intelligent use of it is the use that supplies the steam in needed uniformity, not sometimes high and sometimes low, dependent on the care, or its lack, with which it is indiscriminately pitched into the furnace.

The first care in firing with wood, if in a horizontal boiler, is to keep a good supply of coals at the front of the grates, and the openings of the grates free from ashes that the draft may not be obstructed thereby. The wood should be laid in compactly—reasonable spaces for the flames to spread and arise being provided, especial care being taken that two or more pieces do not lay flat sides together, as the furnace will be robbed of at least two legitimate flames.

In many lumbering districts much of the firing is done with slabs from green timber. In using such fuel, many place the bark side down, under the impression that being the accumulation of dead growths, and dry, it will ignite quicker and burn better. It will, till the dry coat is burned off to the green under it, when all progress will be stopped till that moisture is sufficiently dissipated to allow it to ignite. If the other side of the slab is placed down, while not starting quite so quickly, when started it is started to burn with increasing fervency, till all is consumed—green bark being no obstacle as it is dried out before it is reached. If the utmost capacity of a boiler is required, it will require much care to prevent the fire from getting low while being replenished if the wood be poor. Keep the furnace constantly filled. If the fire is getting nearly burned out, give one shake, together with the poker with a pass or two over the grates to remove the ashes, and immediately fill up with wood. Constantly stirring the fire is a mistake. The main point is to keep plenty of bright coals well in front—the draft will draw the flames back—and the furnace full of wood, with draft doors and damper shut, then if the greater demand for steam is made it is readily furnished by opening—the draft—a reserve fund, payable on demand.

Firing with coal is comparatively easy—the main effort with a fireman who has used poor wood for fuel being to keep it within reasonable bounds. Much is gained by having the kindling wood vigorously burning before the coal is put on. Then it should be put on sufficiently thin to readily burn without smothering the fire. After it is thoroughly ignited and partially coked break the crust and push the mass well back, leaving comparatively but a small portion of burning coals at the front of the grates. Deliver the new supply of coal there. Three important advantages are gained; in the first place, the volume of heat is not checked, as throwing it upon the burning coal would. In the next place, the smoke and gases thrown out by the igniting coal is largely consumed in passing over the burning coal behind it; and lastly, by placing it at the front, the decided advantage of having it coked is had—springing into instant blaze when it is broken up and put with the rest.

Whatever is true of wood is true of coal as regards cleaning the fire. It should be done as quickly as possible. The exposure of the boiler sheets to drafts of cold air while cleaning or replenishing the fire is very destructive, and moreover, admittance of such vast volumes of cold air above, and not through, the grates has a dampening effect on combustion resulting in dense columns of black smoke, which, rising from the top of the chimney unconsumed, give evidence of serious and reckless waste.

Other things being equal, the fireman who displays the smallest telltale in the way of a smoky burner is the cheapest man at a higher salary, for salary is a secondary consideration, especially in steam engineering, efficiency being first and foremost to the owner of the plant, while a fireman, who knowing himself competent and reliable, unless compelled by force of circumstances, will not submit to meager wages.

It is as true of this as any other calling that worth makes the man and wages, and it is eminently true that the capable, careful and industrious fireman will ultimately find his place at his true worth, if he will grasp the opportunities as presented.

THE DEVELOPMENT OF THE STEAM-ENGINE—V.

BY PROF. R. H. THURSTON.

The Stationary Engine.

The stationary engine is, as has been already seen, an evolution from the earlier types of pumping-engine, and is a product of the fertile and fruitful brain of James Watt. The Watt double-acting engine, turning a shaft, regulated by a "fly-wheel" and controlled by the Watt governor, represents the type of the modern stationary engine as well as that of Watt's own time. The changes which have occurred since that period have been mainly in matters of detail.

The old "parallel motion" guiding the head of the piston-rod has now become generally superseded by the guides and sliding cross-head. The valve-gear has been simplified and better adapted to efficient action as a "cut-off" gear. The governor has been so attached as to adjust the steam supply to work momentarily performed, by variation of the point of cut-off, and, revolution by revolution, fixing the ratio of expansion. The general design and construction of the engine have been modified in the direction of simplicity, cheapness and lightness, combined with strength. The use of the direct-acting engine, rather than the beam-engine, is now general, and, for all but "high-speed" engines which make 150 to 300 revolutions or more per minute, some form of "detachable valve-gear" is employed.

The first successful "drop cut-off" engine was that of F. E. Sickels, of 1841, which employed "puppet-valves" on the steam side, which could be detached and allowed to fall into their seats at any desired point in the stroke, by a detaching mechanism operated either by hand or by the governor. To prevent injury by the impact of the valve on the seat, a "dash-pot" was used, consisting of a vessel, containing either water or air, into which a loosely-fitted piston was fitted. This piston, attached to the valve-stem, directly or indirectly, rose and fell with the latter, and when the valve was about to strike the seat at the end of its descent, the fall was checked and the valve "eased" down to the seat by the resistance of the fluid in the dash-pot, on which the piston fell, and through which, for a very short distance, it then forced its way.

Modifications of these devices were devised by G. H. Corliss in 1849, and constitute the so-called Corliss engine of the present time, which will be described later. Many other inventors have since constructed still other engines of the same general character.

The latest improvements of the stationary engine relate to what are distinctively known as the "high-speed" engine, and have led to the production of engines especially adapted to driving machinery at very high speeds of revolution. In the most successful engines of this type it is usual to make the engine itself of the simplest possible design; to adopt a simple valve-motion, and to secure regulation by means of a governor placed on the main shaft and adjusting the point of cut-off by shifting the eccentric. A single valve is often used. These engines will be fully described in the next chapter.

Where the cost of securing the needed condensing water is not too great, and where the steam-pressure is moderate, a condenser may be economically added to the non-condensing engine, thus obtaining a gain in power of considerable amount and an increase in economy of steam and of fuel, if the engine is well proportioned to its work when thus altered, of often one-third—three pounds and two pounds of good coal per horse-power and per hour being common figures for such engines working non-condensing and condensing. The gain in power is often one-fourth or one-third. But with increasing pressure of steam this gain becomes lessened.—[From "A Manual of the Steam-Engine," Part 1st, by Prof. R. H. Thurston, Published by John Wiley & Sons, 53 E. 10th street, New York; 2d part now ready.

Electrical

☞ *The Electrical Lessons recently printed, one of which gave directions for making a dynamo, will soon be completed, when the whole series will be published in a neat volume with paper covers. Every one subscribing after December 1st, 1891, will receive a copy free. This series constitutes the simplest and best instruction for beginners we have yet seen.*

Modern Generators and Motors.

Having presented in previous articles some of the early ideas on the subject of electric generators and motors, we now submit brief descriptions of some of the prominent modern types:

Fig. 1 is a 100 H. P. generator, designed by Sidney H. Short, for the Brush Electric Co. It is of the closed coil armature type. The core of the armature is composed of thin sheet iron wound on an iron foundation ring and firmly riveted together. The edges of this ring are then milled out to allow for the bobbins of wire, thus forming a ring something like that constructed by Paccinotti. The wires connecting armature with commutator are carried along the shaft, but are very carefully covered so as to protect them from injury, while the bearing on the commutator side is placed outside of the commutator, so as to allow a clear way for the shaft wires. The commutator runs practically without sparking at the brushes.

The motor is similar to the generator in its construction, and both machines are very compactly built and so arranged that any part may be inspected or repaired without disarranging other parts. The magnets or armature can be removed easily and quickly, and any bobbin of the armature can be rewound without disturbing the remaining bobbin. The Brush Co. will build these generators and motors for 500 or 1,000 volts, as may be preferred, and of powers ranging in the generators from 50 to 500 horse-power, and in the motors from 5 up to 100 or 150 horse-power.

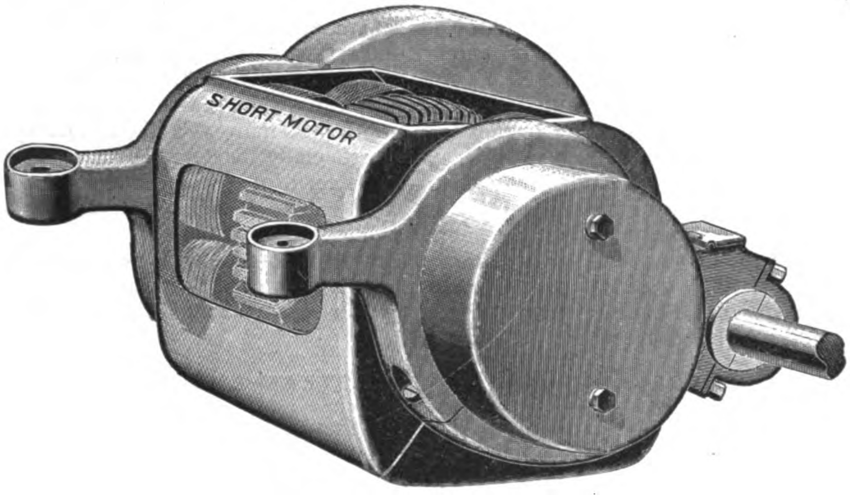

FIG. 2—SHORT SINGLE REDUCTION MOTOR.

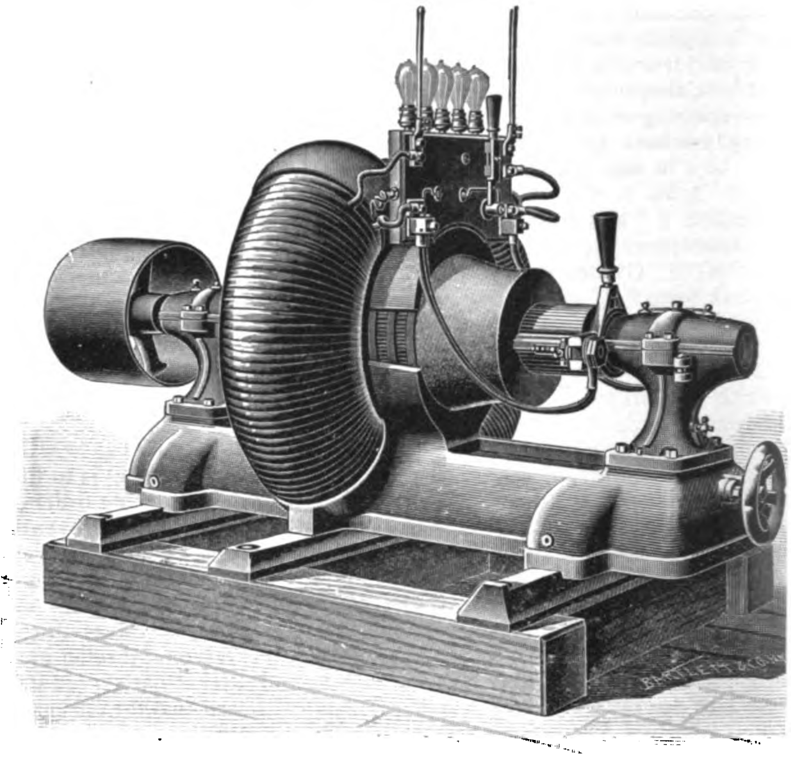

FIG. 3—50 H. P. "C. & C." DYNAMO.

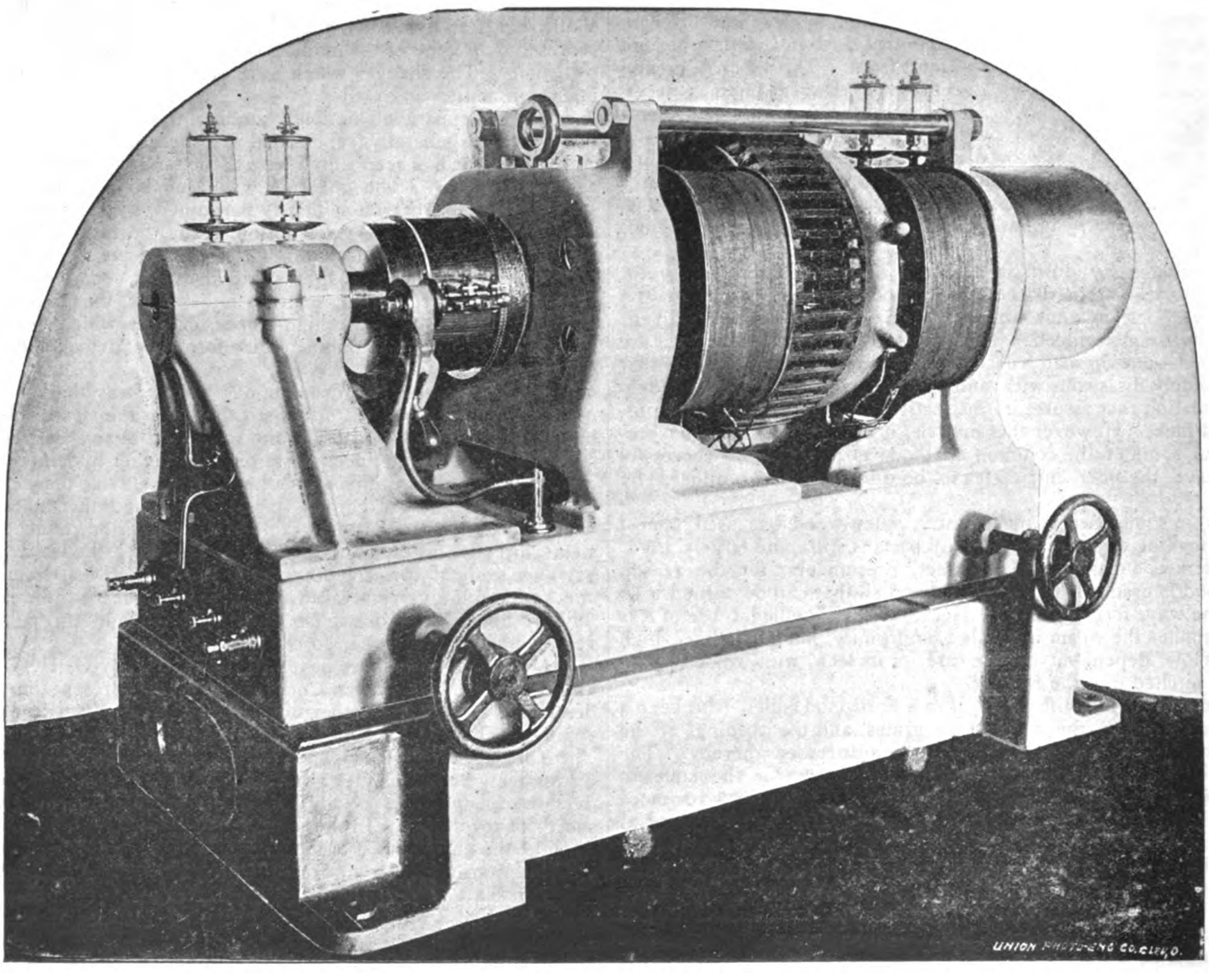

FIG. 1—100 H. P. BRUSH GENERATOR.

We have already illustrated in these columns the admirable type of railway generators, supplied by the Short Electric Railway Co., and have also described their standard double reduction motor and their gearless motor. The Short Co. have now brought out another type designated as the "Single Reduction" or "Water-Tight Motor," and it is this type which is illustrated by Fig. 2. One pinion and one gear have been dispensed with and arrangements made to run the remaining gear in oil. The machines are practically the same as the Short standard motors, and a series of efficiency tests show that in economy of current and in output of power there is little choice between them. The "Single Reduction," however, is smaller than the "Standard," and it is claimed is the lightest and smallest street car motor thus far constructed. It weighs something less than 1,800 pounds; is encased in and entirely protected by its iron frame, and can be operated on 30-inch, 33-inch and 36-inch wheels, and on any gauge of track down to three feet.

This motor is specially adapted to narrow gauge roads and for mine haulage purposes. It is made in two standard sizes; fifteen and twenty horse-power.

Times consumed in repairs enters into every record kept by street railway companies, and one of the valuable features of the Short apparatus is the facility with which it can be repaired. A car can be run over a pit and every part of the motor reached without difficulty. The commutator, field coils and armature are easy of access and the armature can be removed, in case of necessity, by two men in eight minutes, its weight being only one hundred and ninety-eight pounds. In fact every part of the motor can be removed without taking the machine to pieces. The bearings of the car motor are twice oiled and the comparatively slow revolution of the armature reduces natural wear to a minimum. The Jamestown (N. Y.) Street Railway operated ten cars from June tenth to August twenty-ninth, a period of eleven weeks, with a total loss of but two car days. On the Rochester (N. Y.) Railway, during eight months of operation, the total cost of repairs, including material and repairs to electrical machinery, was but four mills per car mile, and the average loss per car was but four per cent. of the total mileage.

Fig. 3 is taken from a photograph of a fifty horse-power "C & C" dynamo, placed on the market by the "C & C" Electric Motor Co., No. 402–404 Greenwich street, New York City, during the past Summer. The design is similar to that of the well-known circular field and consequent pole motor, already so familiar to the public. The machine represented is wound for five hundred volts and specially designed for power circuits. For a long transmission of power this can be specially wound to give perfectly automatic regulation under the very greatest possible variation in load. A substantial terminal board is bolted to the upper pole-piece, and is provided with a heavy knife switch for opening the main circuit. This board also carries the field and armature connections, all of which are of solid metal and in plain view. The commutator is of the most substantial construction, being built up of heavy copper bars insulated with the best mica. With proper care it will last for years. The mechanical construction is of the best throughout, skilled mechanics and the most improved machine tools being employed. The armature is wound to carry a much greater volume of current than the nominal capacity of the machine requires, thus making it practically impossible to burn them out by overheating. The circular shape of the magnets gives them the greatest possible development of power for least weight.

The one hundred horse-power dynamo made by this company is of exactly the same form as the dynamo here illustrated, and is especially suitable to be used as a power generator for street railway circuits, its high efficiency and mechanical excellence making it a favorite with station superintendents.

These dynamos are wound in standard sizes, from one horse-power to one hundred horse-power, for electric lighting as well as for power transmission, and especially for isolated plants and for use in mills, office buildings, banks, etc.

E. M. F.

[To be continued.]

ERECTING STEAM POWER PLANTS.—I.

BY JAMES F. HOBART.

After the determination has been made to erect a steam plant, careful calculations should be made and estimates formed of the total amount of steam necessary to do the work required. There is nothing more aggravating than to find after erecting a nice steam plant that the addition of one or two necessary machines has reduced the boiler or engine capacity so that the power is insufficient. Some kinds of manufacturing require that the boiler plant be capable of increase within a few months or years, while other kinds of manufacturing will probably not need to be changed from the time they are erected until the plants are rebuilt. An electric light plant is a good example of the first. In putting in a plant for making electricity, it is safe to figure on double the capacity required when the plant is installed. Six months' time will suffice to render this increase necessary.

A flour or grist mill, on the other hand, will not require an increase of power for years, if ever. After a careful estimate has been made of the horse power required, add a liberal percentage for increase, according to the business to be engaged in. Next, take into consideration the kind of fuel that must be burned. If good soft coal or even hard coal can be burned all the time, the conditions will be different from those requiring a consumption of sugar-cane, sawdust, tanbark, or any of the cheaper varieties of local fuel. If coal is to be used, there should be a grate surface area of one square foot for a combustion of 15 pounds of coal per hour. The length of the grate should not exceed one and one-half times the width of the furnace, and the bars should be set at an inclination toward the bridge wall of one inch to one and one-half inches in every foot of their length.

This percentage of grate area will serve for the higher classes of combination when there is great chimney draft or when a blower is used. When the rate of combustion is not high because the lower grades of fuel are used such as tanbark and bagasse, the proportion of grate area should be increased to one foot for every twelve pounds of fuel. The width of the grate bars should in all cases be the least practicable. The spaces between the bars should be from one-half to three-fourths of an inch, according to the fuel used. Sawdust and culm require the finest grate, while wood and furnace coal being better burned upon grate bars spaced a greater distance apart.

The depth of a grate bar should be six-tenths of the square root of its length, all measurements being taken in inches. The efficiency of a boiler furnace depends more upon the proper size of the ash pit than many engineers imagine. For a combustion of 15 pounds of coal per hour, the transverse area of the ash pit should be from two-tenths to twenty-five-hundredths times the area of the grate surface, this size being best for bituminous coal. For anthracite coal from twenty-five hundredths to three-tenths is best. In other words, a furnace 42" in width should have a depth of ash pit of from 15" to 20".

The combustion chamber for coal should have a volume of two and seventy-five-hundredths to three cubic feet per foot of grate surface. For wood, a volume of four and six-tenths to five cubic feet is required for each square foot of grate surface. The higher the rate of combustion, the greater the volume. For this reason, bituminous coal requires more room than anthracite.

It is well to bear in mind at this point that there must be sufficient opening between the grate bars to supply the amount of air necessary for the combustion of the coal. The velocity of a current of air entering an ash pit is usually estimated at twelve feet per second. To maintain this velocity, a much higher velocity is necessary through the combustion chamber, tubes and chimney of a boiler. The moment cold air enters through the grate into the ignited coal, its volume is increased about six times; therefore, its velocity must be increased in the same ratio unless the conducting passages be made enough larger in cross section to reduce the velocity of the heated air and gases to a point nearer that of the air as it enters the ash pit.

From 1,800 to 2,000 cubic feet of air are required for combustion purposes to convert one cubic foot of water into steam. When wood is burned, nearly 4,000 cubic feet of air are necessary to make the same amount of water into steam. The rate of combustion in pounds of coal per square foot of grate surface per hour is from ten to 16 in stationary boilers under natural draft. Where forced draft is used, the combustion may be increased to nearly 120 pounds of coal per square foot of grate surface per hour.

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Action of Various Oils on Metals.

A series of tests, covering some twelve months, on the action of various oils on metals in contact with them, recently carried out, gave the following results: In the case of iron, seal oil acted the least on it, and tallow the most. Bronze was not attacked at all by colza oil, and but very slightly by olive oil, while, on the other hand, it was vigorously eroded by linseed oil. In the case of lead, the most deleterious lubricant was whale oil, and the best was olive. Whale, lard and sperm oils were about equally erosive. Zinc seemed to be but little attacked by mineral lubricant oils, the best oil being lard and sperm the worst. Copper was not attacked by any of the mineral oils; sperm oil had the least and tallow the most action on it. Generally speaking, mineral oils attacked the metals under test the least, and sperm oil attacked them the most. In conducting these experiments, the metals were first thoroughly cleaned in ether and then dried. They were next carefully weighed and placed in closed vessels filled with oil, which were kept for a year at a uniform temperature in Summer of 80° Fahr., and in Winter of about 50°.

Don't Turn the Exhaust into the Sewer.

Steam should never be put into a brick or cement sewer, as it has an injurious effect on the same, causing disintegration and collapse within a very short time; neither should it be led into a brick chimney for the same reasons. In some places it is the practice of engineers to turn the exhaust from pump or small engine into the sewers, but this is bad practice, and, we believe, an illegal act in some cities, for it will not only destroy the sewers, but the heat of the steam makes the malarial gases more active, while at the same time it produces a certain amount of pressure that will force the gas back into the buildings through the water traps commonly in use. In these traps there is seldom more than three inches of water, and very little pressure is necessary to force the gas through them. Wherever gas is forced back through buildings in this or a similar manner the death rate in that locality will certainly be greatly increased.

Rapid Steaming Boilers.

Recent improvements in boilers, especially those of the water-tube type such as are put into high speed gun-boats, torpedo-boats, etc., show considerable increase in the power developed from a given weight of boiler and water over those formerly in use. A gun-boat was recently equipped and furnished with a water-tube boiler in which all of the tubes were straight and it supplies steam for the development of from 90 to 100 horse-power per ton weight of boiler, including water, as reported after the test. A clear description of the boiler was not given, but if such power can be developed from such a weight of material it shows an extremely high evaporative efficiency.

In a gas engine plant recently established in England, where the gas used in the engine was manufactured on the spot from coal, it was shown that a brake horse-power was developed from a consumption of 1.23 lbs. of coal, and allowing for friction it would give an indicated horse power from less than one pound of coal. In this case the engine, itself, showed an efficiency of but 69 per cent., which is considerable lower than that shown by some of the best steam engines, but the result of the test would tend to prove that very much higher efficiency is obtained from the fuel when the combustion takes place within the cylinder of the engine where the heat is applied direct.

GILL'S WATER TUBE STEAM BOILER.

The rapid growth in popularity of the water tube type of steam boiler has been the best evidence of its economy in space and fuel, its safety, its durability and its general superiority. An approved type is herewith illustrated. In the construction of the Gill boiler, the water tubes, four inches in diameter and spaced about three inches apart, are inclined at an angle of about fifteen degrees from the horizontal. Each nest of four or five tubes is expanded into a cast-iron box or header at each end in such a way that the tubes are staggered instead of being placed one above the other. By thus making these boxes short, and by connecting them by slightly flexible tubes, the danger of breakage is entirely avoided, which is of common occurence where the headers are made in one long cast-iron box. The connection between the headers and the steam and water drum over head is exceedingly simple, consisting of short tubes which are expanded into the top of the headers and into the drum entering the latter radially, for which purpose they are curved to the proper form.

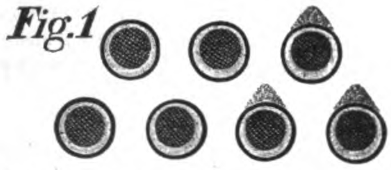


Fig.1

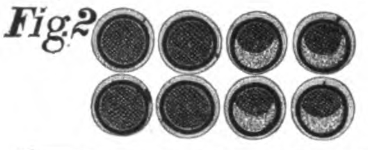


Fig.2

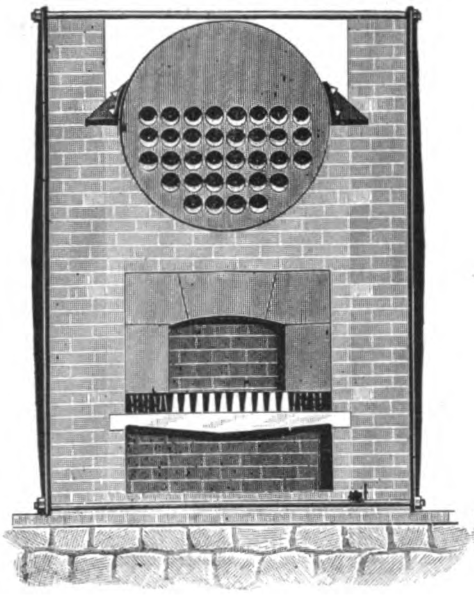


FIG. 3.

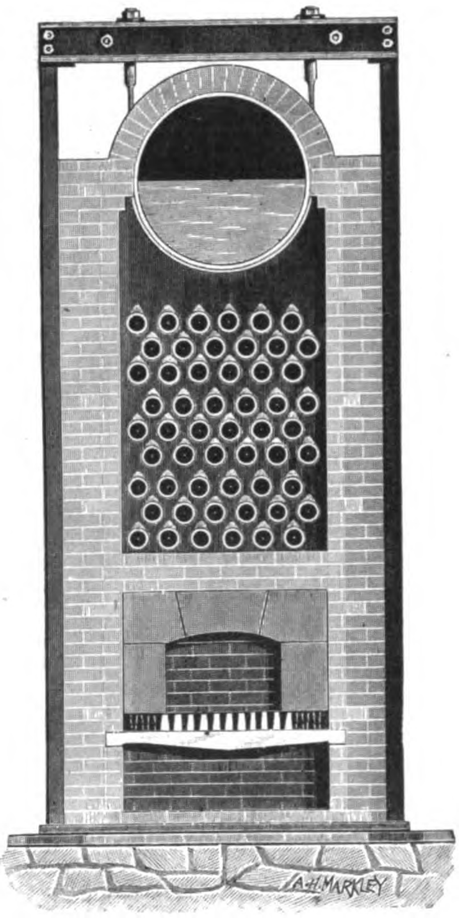
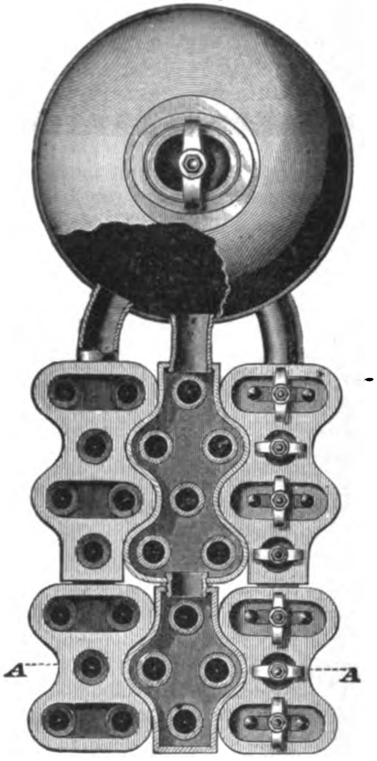


FIG. 4.

FIG. 5.


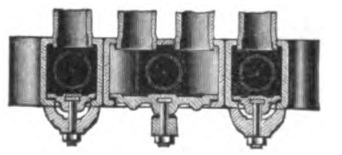
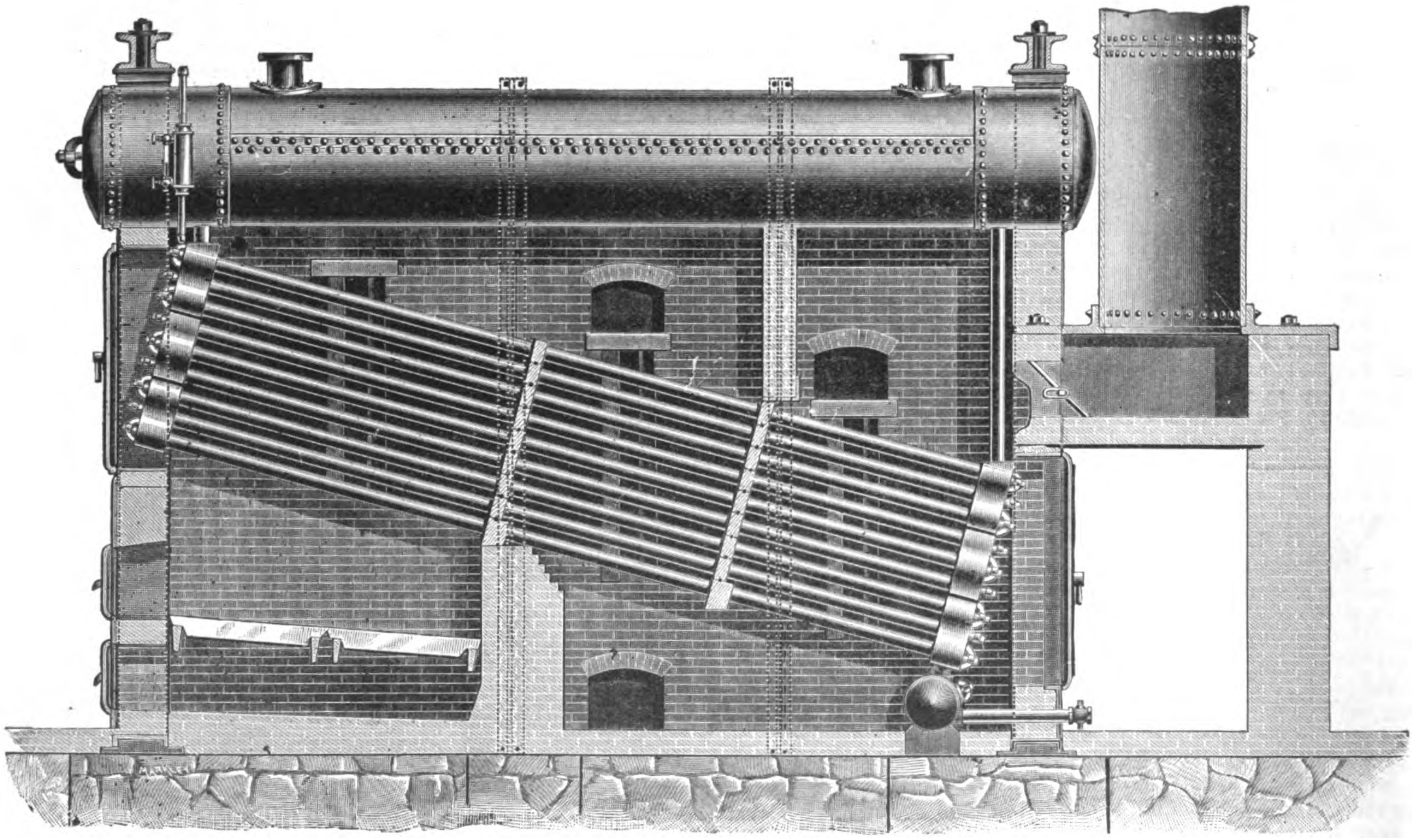


FIG. 6.


GILL WATER TUBE STEAM BOILER, WITH IRON STACK.

The drums are made in sizes varying in diameter from 30 to 50 inches, proportioned so as to allow a cubic foot capacity for steam space and a cubic foot for water storage in the drums for each horse-power developed. Thirty-inch drums have been found to be the smallest size that will allow of the production of dry steam under conditions of rapid driving. The drums are made of the best steel, and the thickness is proportioned for the highest pressure desired, with ample factors of safety. The bank of tubes is divided into two or three sections by one or two flame walls made of fire brick, firmly secured by rods running through them and into the side walls. The flame and heated gases are thereby compelled to traverse the tubes two or three times before finding their exit at the rear end of the furnace. It will be observed that the tubes receive the most intense part of the heat, and absorb the larger amount of it before it reaches the drum, consequently the drum is not subjected to the same destructive forces that it would otherwise be, and therefore there is scarcely a possibility of a disastrous explosion of the drum. Out of the many hundreds of thousands of horse-power of boilers of this class that have been built since their introduction by Dr. Alban, in 1840, we do not know of a single instance of an explosion of one of these drums.

Under the rear row of headers is placed a mud drum, usually 18 inches in diameter, connected to the bottom headers by short nipples. This drum serves to collect the sediment floating in the water, and hold it until it is blown off.

Long narrow cleaning doors are built in the side walls of the brick setting, through which a hose with a steam nozzle may be inserted, for the purpose of blowing off the dust which gradually settles on the tubes. Two or three man-hole doors are also built in the side walls to allow an operator or inspector to enter the furnace above and below the tubes for cleaning or inspection. The furnace is built with an opening the full width of the furnace and the full height of the bank of headers, at both the front and rear of the tubes. Large doors are used to close these openings so as to prevent as much as possible the loss of heat. Upon opening these doors access is had to all the sectional parts without the necessity of entering the dusty furnace.

The illustration, Fig. 5, shows a bank of Gill's patent headers and a steam drum, with their connections. The column at the left hand shows a five and six-hole header with the caps removed, and the curved tube connection with the steam drum. The column at the right shows a five and six-hole header, with their inside hand-hole caps, bolts and dogs in place The middle column shows a four and six-hole header—in section at the middle of the headers—showing the manner of connecting the headers with each other, and the headers with the steam drum. The small illustration, Fig. 6, at the bottom, shows a section through the three headers and four tubes, at the line A A. Fig. 7 shows a pair of five tube headers, with five tubes, the hand-hole caps and the short nipples in place.

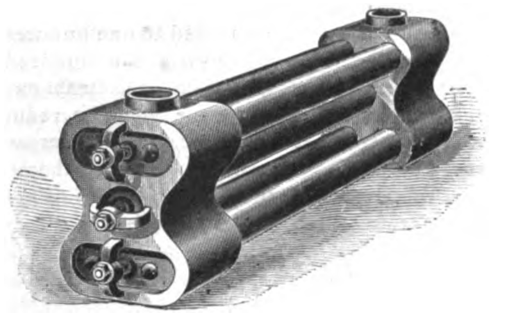


FIG. 7.

Hand-holes are provided in the headers at the front and rear of all tubes through which a scraper (having a long, straight and firm handle) is used to remove any sediment or scale that may have lodged in the tubes or in the headers. The tubes may also be removed through these hand-holes when necessary and new ones inserted. The openings are closed with caps placed inside of the headers. They are packed with thin rubber gaskets and are held in place with bolts one inch in diameter. The outward pressure of steam against these caps helps to make a tight joint, and should it be possible to break these bolts the pressure of steam would hold the caps in place and thus prevent the accidents that frequently occur with other water tube boilers which use outside caps, held in place only by the bolt, viz: the breaking of the bolts, blowing off the caps, scalding the firemen and other person that may be in the boiler room.

A man hole is placed in the steam drum, by which it may be entered and cleaned. In this way every portion of the internal surface of the boiler may be reached and thoroughly cleaned from scale. The frequency of cleaning will depend entirely upon the character of the water used. With some waters, occasional blowing out of the mud drum is all that is needed, but with bad waters, containing much carbonate or sulphate of lime, cleaning may be required once a month or oftener. Where the water is bad a good purifier will be found very serviceable, a good heater should always be used.

The furnace used with the Gill boiler may be of any kind that is used with any other boiler. The kind to be used will vary in different cases, according to the kind of fuel to be used. The boiler is especially adapted to the use of gaseous fuel and to automatic stoking. A structural frame work, composed of wrought iron I beam columns, and channel bar cross beams, firmly united with brackets, bolts and rods is erected, within which the drums, tubes and headers are suspended. The drums are supported in swings that are not attached to the drums, thus allowing the working parts to expand and contract independently of the structural parts. All the iron work is made complete before the brick work is commenced. The cast iron front, full height and width of the structure, is made in sections, and so united as to allow of free expansion to all the parts. The fire and ash doors have openings which are provided with wickets to control the admission of air to the furnaces. Although very plain, it is neat in design, as will be seen by reference to the illustrations.

Following is a comparison between a Gill water tube and a return tubular boiler:

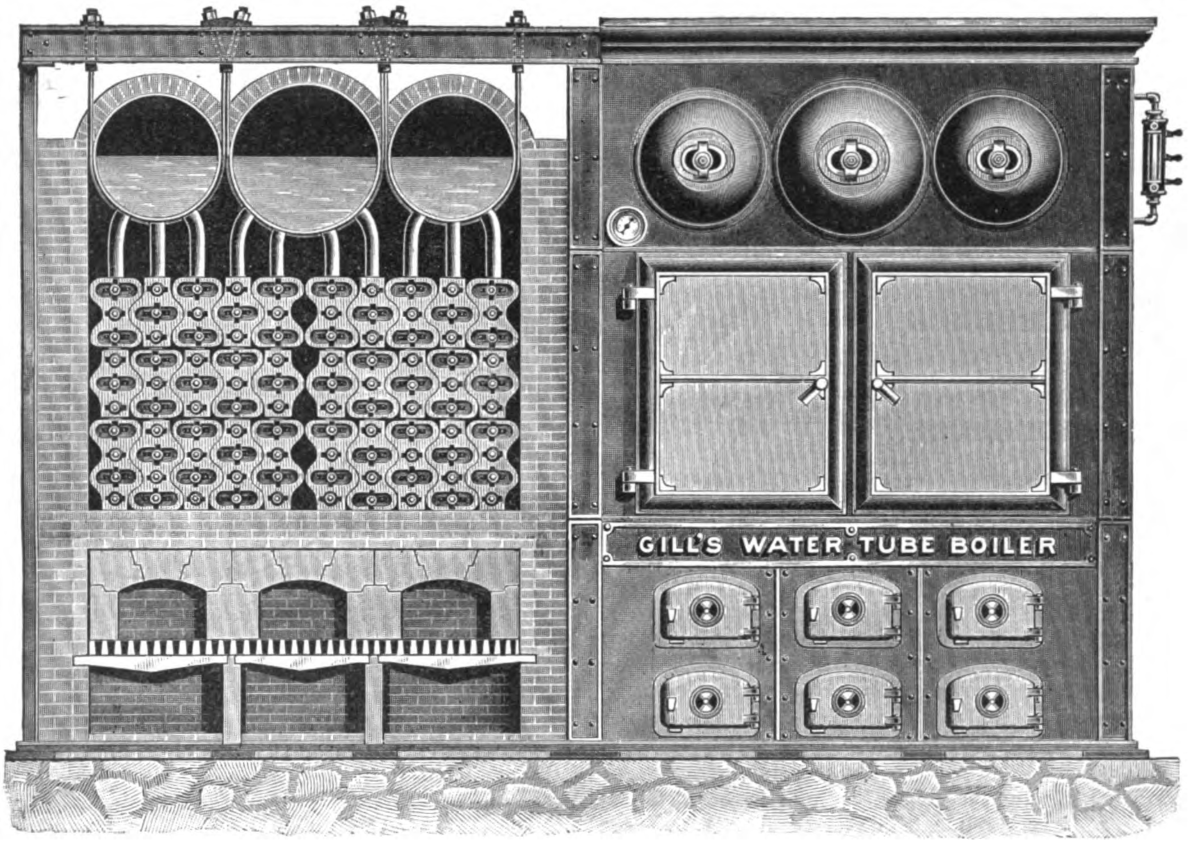
GILL WATER TUBE BOILER.

Shell 42 inches diameter by 20 feet 6 inches long, one-half being exposed to the heat gives	100 sq. ft.
54 tubes 17 feet long gives	961 sq. ft.
Total heating surface	1,061 sq. ft.
Less 25 per cent. of the tubes when covered by ashes	240 sq. ft.
Total available heating surface	821 sq. ft.

RETURN TUBULAR BOILER.

The shell of the tubular boiler, 4 feet in diameter by 17 feet in length and taking 60 per cent. for exposure to the heat, gives	130 sq. ft.
Add to this the heating surface of: 34 tubes 4 inches diameter	566 sq. ft.
Total heating surface	696 sq. ft.
Less one-half of the tubes (the bottom half being covered with ashes)	283 sq. ft.
Total available heating surface	413 sq. ft.
The non-available heating surface having been eliminated, eight square feet will produce a horse-power, this makes the return tubular boiler	51 horse-power
and the Gill water tube boiler	102 " "

It will be seen that a 50 horse-power tubular boiler requires exactly the same ground space that may be occupied by a 100 horse-power Gill water tube boiler. Both boilers are four feet wide, and the side walls 18 inches, making the full width of the brick work seven feet. The length of the setting depends on the length of the tubes, and is about three feet longer than the tubes, with either type. Fig. 2 shows a nest of seven four-inch tubes as arranged in the water tube boiler with a space of three inches between the tubes; this space never changes, as the ashes do not collect on the sides of the tubes. When the ashes are not blown off with a steam jet, they will accumulate in a wedge shape, as shown in the three tubes at the right of Fig. 1, rendering 20 to 25 per cent. of the surface of the upper part of the tube ineffective. It will be apparent upon examing Fig. 1 and Fig. 4 that the passage way for the moving of the gases will always be open and free. In a boiler of 100 horse-power, this space is four feet wide, less the space occupied by six tubes four inches in diameter, which equals two feet, one half the width of the furnace; this multiplied by seven feet, the length of the furnace, makes the full passage way 14 square feet. This passage way is so large that if the flame should go out at times, the gases will again ignite by a flash from the furnace. Fig. 2 shows a nest of eight 4-inch tubes as arranged in the ordinary tubular boiler; this arrangement is again shown in Fig. 3, with a space between the tubes usually from one to one and a-half inches. The four tubes at the right of Fig. 2 and all the tubes in Fig. 3 show an accumulation of ashes in them. Every person that had to do with boilers of this kind has undoubtedly seen tubes filled with ashes as much as this illustration represents. The majority of engineers having charge of boilers of this description have their tubes blown out and scraped frequently, and seldom allow their tubes to get into such a bad condition; yet it must be admitted that, upon examination, the average normal condition of the tubes will show them partially filled with ashes, rendering the lower half, or 50 per cent. of the tube, worthless as heating surface. It will also be observed that all the gases have to pass through the tubes. The total area of 34 4-inch tubes in the 50 horse-power boiler is but 2 96 square feet, or 5.92 square feet in two boilers aggregating 100 horse-power. This will be reduced at least



TWO 450 H. P. BOILERS ARRANGED IN ONE BATTERY.

(Continued on page 12)

APPARATUS FOR SUPPLYING MOTIVE FLUID TO ENGINES.

Benjamin Brazelle, of St. Louis, has recently invented a new and useful improvement in methods of and apparatus for supplying motive fluid to engines.

The object of the invention is to attain as high an economy as practicable in the operation of fluid-pressure engines by utilizing the expansive force of motive fluid from any determined initial pressure, whether comparatively high or low, to a fixed low or zero terminal, irrespective of variations of load or initial pressure—in other words, to enable the maximum economy to be attained whether the duty of the engine requires the development of its maximum or its minimum power.

Under present practice an engine which may operate economically when exerting, say, one hundred horse-power will not be found economical when operated at ten horse-power, and hence no material range of variation of load is usefully admissible. Further, in the operation of an engine in which a desired terminal pressure is attained, when steam is worked at maximum pressure, and with a determined degree of expansion the terminal will be found to fall much below atmospheric pressure with the attendant loss due to condensation and re-evaporation when cutting off shorter for lighter loads or higher pressure. Again, in automatic cut-off engines it is not practicable to effect perfect regulation within any material range of variation of load or pressure.

This invention is designed to obviate the objections which, as above indicated, obtain in present practice; and, generally stated, it consists in a method of and apparatus for coincidently changing the degree of expansion or point of cut-off and the degree of initial pressure, in accordance with variations of pressure or load, or both, in the operation of an engine, expansion being varied in reverse direction to the variation in ordinary practice—that is to say, the point of cut-off being made earlier in accordance with increase of load or pressure and later in accordance with decrease, while the same fixed low terminal is reached in all cases. The load-line is so regulated as to be brought to the fixed terminal by varying the point of cut-off, as above stated, and the pressure-line is correspondingly and coincidently regulated by varying the initial pressure from which expansion is effected.

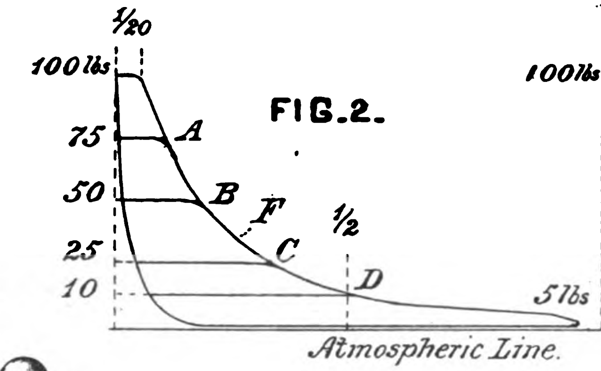


FIG. 2.

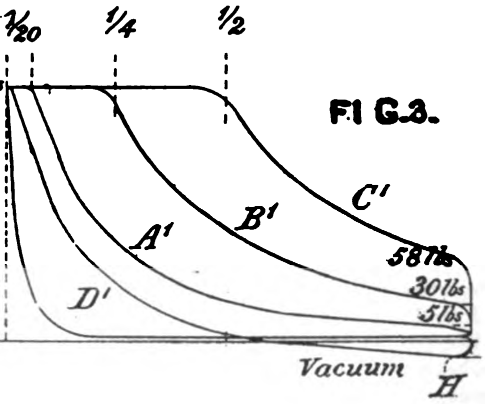


FIG. 3.

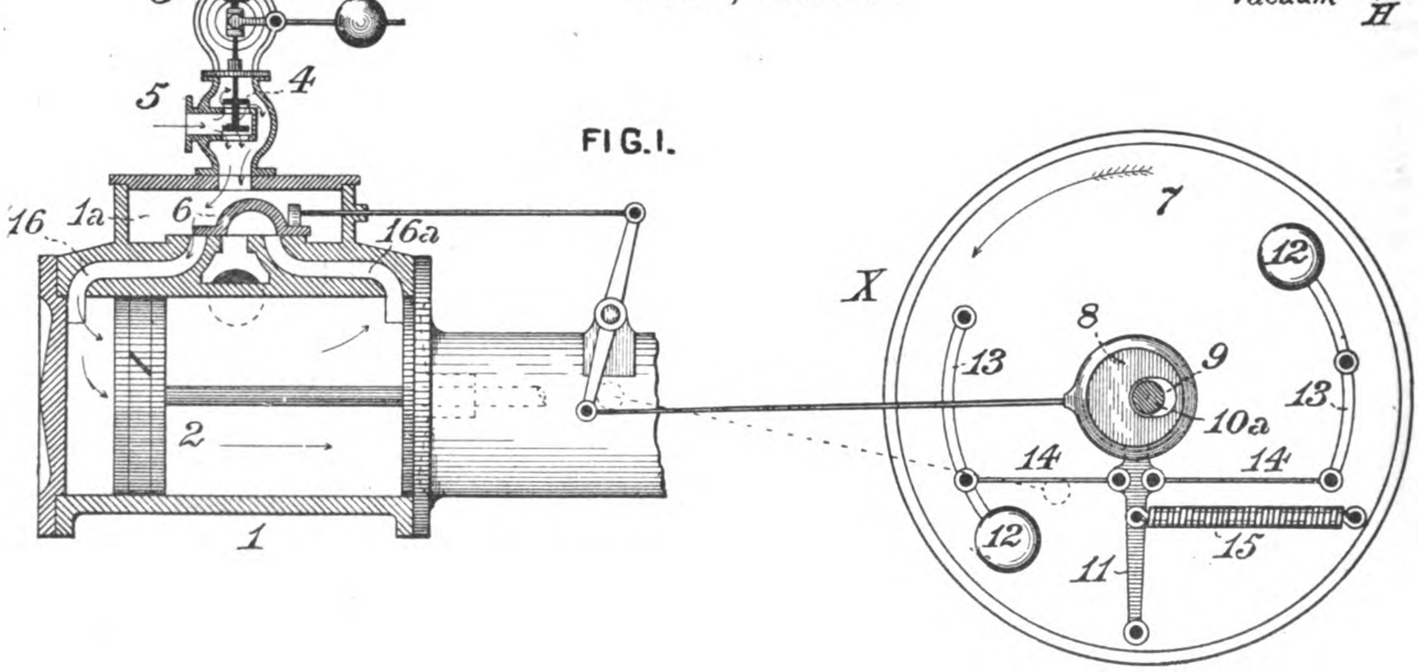


FIG. 1.

In the practice of this invention as applied in the operation of engines of the present standard construction a cut-off mechanism and a fluid-supply valve are coincidently acted upon by a regulating mechanism of any suitable construction, so as to simultaneously vary the degree of initial pressure and the point of cut-off, raising the former and shortening the latter in accordance with required increase of power, and, conversely, lowering the former and lengthening the latter in accordance with required decrease of power. Such variation may be effected by the employment of two governors or regulators, one of which acts upon the cut-off mechanism and the other upon the throttle or supply valve, or by a single regulating mechanism of such construction as to be adapted to act simultaneously upon the cut-off mechanism and the throttle-valve.

In the accompanying drawings, Fig. 1 is a view, partly in elevation and partly in section, of so much of an engine adapted to the practice of this invention as is necessary to explain the same; Fig. 2, an indicator diagram such as would be produced under the invention, and Fig. 3 an indicator diagram such as is produced in the operation of an ordinary automatic cut-off engine.

The drawings illustrate the application of this invention on an automatic cut-off slide-valve engine of the ordinary type, the distribution-valve being actuated and controlled by a loose eccentric and cut-off governor on the main shaft, and the steam-supply being controlled by an ordinary centrifugal throttling governor connected to the steam-pipe and valve chest. Motive fluid is admitted through the inlet 5 and governor valve 4 to the valve-chest 1^a and thence through the ports 16 16^a to the cylinder 1, acting upon the piston 2, which, through the usual connections, rotates the crank-shaft 10^a. Motive-fluid supply is regulated by a throttling-governor 3, and variation of the degree of expansion or point of cut-off is effected by a cut-off governor or regulator X, mounted on and rotating with the crank-shaft. The governor X is composed of a supporting disk or case 7, fixed upon the shaft 10^a a pair of centrifugally-acting weights 12, connected to arms 13, which are pivoted to the case and coupled by links 14 to an arm 11, carrying a movable eccentric 8, and a centripetally-acting spring 15, coupled to the case and to the eccentric carrier arm 11. A slot 9 is formed in the eccentric 8, through which the shaft 10^a passes, and the rod of the eccentric 8 is connected with the slide distribution-valve 6 in the ordinary manner.

The engine may be assumed to be speeded to one hundred revolutions per minute and to develop fifty horse-power with one hundred pounds initial pressure cut off at one-twentieth of the stroke, the steam expanding down to five pounds terminal pressure. Should the load be reduced or pressure increased, the speed of the engine would be slightly increased, causing the throttling-governor 3 to partially close the valve 4, thereby reducing the supply-pressure. At the same time the weights 12 of the shaft-governor X move outwardly, and, through their arms 13 and the links 14, move the eccentric 8 traversely to the shaft, increasing the throw of the eccentric and the travel of the distribution-valve 6, thereby effecting a greater degree of opening of the ports 16 16^a and cutting off later in the stroke. When the load is increased or the pressure reduced and the speed of the engine thereby reduced' the throttling governor 3 will open the valve 4, thereby increasing the initial pressure in the cylinder, and at the same time the weights 12 of the cut-off governor X will move inwardly, when the spring 15 will move the eccentric 8 in the opposite direction, reducing its throw and the travel of the valve, thereby effecting a lesser degree of opening of the cylinder-ports and cutting off shorter. The coincident action of the supply and cut-off governors, as above described, is exerted in accordance with all changes of load and steam-pressure.

The diagram Fig. 2 indicates the different points of cut-off corresponding with variations of initial pressure. If the initial pressure falls to seventy-five, fifty, twenty-five, or ten pounds, the point at which steam is cut off will be indicated by A, B, C, or D, respectively, the terminal pressure being in each case five pounds or the determined terminal or zero of the normal initial pressure of one hundred pounds. Upon a proportionate decrease of load the initial pressure is reduced by the throttling-governor 3 to seventy-five, fifty, twenty-five, or ten pounds, and the point of cut-off changed by the cut-off governor X to that indicated by A, B, C, or D, respectively, the terminal pressure being in each case five pounds. Under other variations of load or initial pressure, occuring either independently or coincidently, the degrees of initial pressure and points of cut-off would be indicated by points between the lines A, B, C, and D, but on the same expansion-line F and resulting in the same fixed terminal.

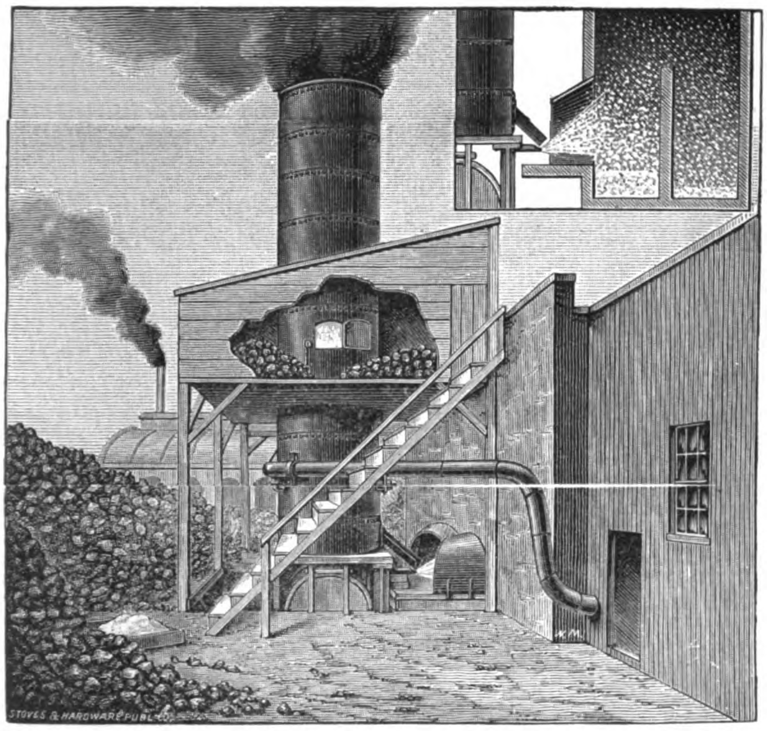
From the diagram Fig. 3, which indicates the results of the ordinary method of using steam expansively in automatic cut-off engines, it will be seen that when the initial pressure is one hundred pounds and the steam is cut off at one-twentieth of the stroke the terminal pressure is five pounds; but when, with an increase of load, the steam is cut off at one-quarter of the stroke the terminal pressure is thirty pounds, and when, with a maximum load, the steam is cut off at one-half the stroke the terminal pressure is fifty-eight pounds. With a minimum load the steam is cut off at so early a period in the stroke as to cause a vacuum to be formed in the cylinder, as indicated by the loop H, the disadvantage of which in resultant condensation and re-evaporation is well understood. The expansion curve with minimum load is shown by D'.

In this improved method, with maximum load, steam at an initial pressure of one hundred pounds is cut off at one-twentieth of the stroke, giving a terminal pressure of five pounds, and with a minimum load the initial pressure is reduced to ten pounds and steam is cut off at one-half stroke, giving a terminal pressure of five pounds.

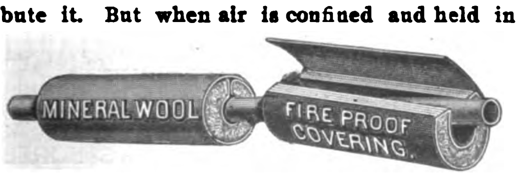
MINERAL WOOL.

Mineral wool is essentially a vitreous substance converted to a fibrous condition. In appearance it consists of a mass of very fine fibers interlacing each other in every direction, thus forming an innumerable number of minute air cells. The resemblance of these fibers to those of wool, or cotton, has given to the material the name of mineral wool in this country, and silicate cotton elsewhere, but it is only in appearance and softness that any similarity exists between the mineral and organic fibers. Mineral wool appears in a variety of colors, principally white, but often yellow or gray and occasionally quite dark. The quality of the wool is not at all dependent upon, or affected by, its color, as all the peculiar properties which constitute its value are present in equal proportions in any of the shades. Mineral wool partakes of the nature of glass without its brittleness, the fibers being soft, pliant and inelastic. They are of irregular thickness and cross each other in all possible directions. It is made by converting scoria and certain rocks while in a melted condition to a fibrous state.

By the improved processes of manufacture lately invented and perfected by the Western Mineral Wool Co., and which was patented March 3, 1891, the quality of the wool produced by them is much improved in strength of texture, lightness, and freedom from dross over that hitherto made.

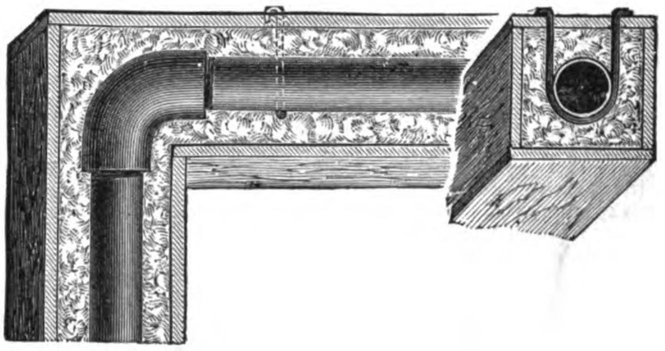


One of the most important qualities of mineral wool is its unequalled power to resist the transmission of heat and cold. No other material, either natural or manufactured, which can be used practically in the arts, approaches this as a non-conductor of heat. This can readily be accounted for in the fact that mineral wool holds in confinement a greater proportion of air than any other material. "Air is so subtile and rapid in movements when unconfined, and so slow to carry heat, except by its own motion, that it is at once the best distributor of heat and also the greatest barrier to its transmission, according as it has, or has not, freedom to circulate." So long as air may circulate at all it is conveying heat from one place to another. An air-chamber, whatever its size, if sufficient to permit any movement of the air, fails as an insulator of heat, although the air may be confined to the chamber, for any difference in the degree of heat affecting the distinct sides or parts of the air space will impart motion to the air, which continually changing place will convey the heat and distribute it. But when air is confined and held in position by a medium, the heat must be conducted, not conveyed. Further, if the air-confining material is not loose and porous and of small percentage as compared with the volume of air it encloses, the encasing material itself will transmit heat, and the more compact the material the greater its capacity for conducting heat.

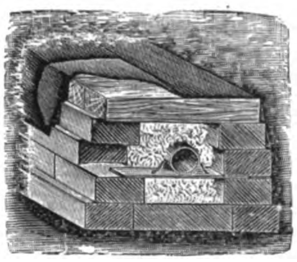


The above cut represents one section of mineral wool pipe covering applied and closed on the pipe, and the other section open, but about to be closed by folding and pasting down the lap.

In converting the vitreous substances into mineral wool of the ordinary grade, it is found that the material increases in bulk twelve times, so that the resulting fibers encase twelve times the quantity of air that the material did before conversion. In other words, a given quantity containing 100 per cent. of material before transmission, contains afterward but 8 per cent., the remaining 92 per cent. of its volume being air held in close confinement in the myriad of minute air cells. In the same way the select grade has 94 per cent., and the extra grade 96 per cent. of its volume of air. It is certain that this proportion of air is not encased by any other product, natural or artificial, which is at the same time indestructible.



In covering exposed water pipes and under ground steam pipes with loose wool the material must be held in place by a jacket expressly provided for it, as will be seen by the above illustration, which shows a pipe enclosed in a box with mineral wool packed around it. In pipes underground thus enclosed tarred paper should be used over the top of the box to keep out the water.



The best way to insulate underground pipes is to run them in brick trenches. The accompanying illustration shows how the New York Steam Co.'s underground pipes are laid and insulated with mineral wool. Materials required for 100 feet of brick trench for 2″ steam-pipes: 1,500 brick laid in hydraulic cement; 200 feet board measure of 2″ spruce planking; 200 square feet of tar felting; 50 pounds cast iron supports; 22 cubic feet of mineral wool space.

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Electric Arc Welding Abroad.

One of our English contemporaries has recently given a very complete account of the Bernardos arc welding process, as operated at the tube works of Lloyd & Lloyd, in Birmingham, which we reproduce in our columns this week. Arc welding and the Thomson process seem to occupy quite distinct fields. The arc method has its peculiar usefulness in connection with large work in which the electric arc serves simply as a means of communicating very intense heat at the particular point necessary. As will be seen from the article in question, it is applied with great effect to the manufacture of tubes, and gas, steam and water fittings generally. Until its introduction the makers were dependent on a powerful blowpipe for doing this rather delicate class of work, but the electric arc from its great power and convenience, has proved to be immensely more effective than any form of blowpipe yet devised, in fact Lloyd & Lloyd report that the cost of the weld by this process is only one-fourth that which was usual when the blowpipe was employed. It will be noted that the Bernardos process is also widely different from the Coffin system of arc welding, which has already been used in this country. Of the two it must be confessed that Mr. Coffin's method is the more pleasing, since by the action of a magnet it converts a powerful arc into a blowpipe which can be handled so as to apply just the right amount of heat at just the point necessary. By the Bernardos process the arc is drawn between the metal itself and the carbon electrode. Inasmuch as the work forms the positive pole, the heat generated is very intense, but the process gives the impression of being less handy than the one just mentioned. It is certainly successful, and enables a class of work to be very readily done which would be impossible by any other process. For example, fittings 12 inches in diameter can be made out of 5-16 metal cheaply and rapidly, a feat which would be exceedingly difficult, if not impossible, to perform by other means. Apparently, arc welding has come to stay, at least in its application to certain classes of work.—[Electrical World.

News Notes.

The Syracuse Steel Works, at Syracuse, were destroyed by fire the 7th inst. The loss is $45,000.

The plant of the Houghton Foundry & Machine Co., at Toledo, O., has been damaged by fire to the extent of $25,000.

The Lancaster, O., Iron Works, recently purchased by the Indiana Iron Works, of Muncie, Ind., are being removed to the latter city.

At South Lawrence, Mass., the Emerson Manufacturing Co. have begun the erection of a new machine shop. The main building will be 375x40 feet, and the foundry 100x60 feet.

GILL'S WATER TUBE STEAM BOILER.

[Continued from page 9.]

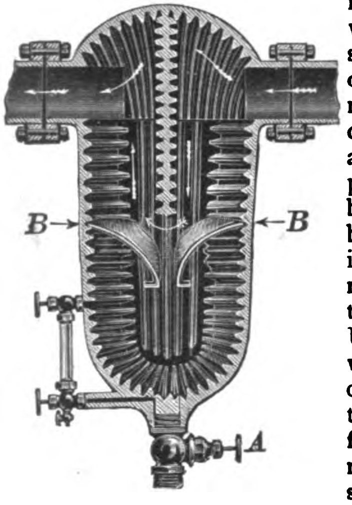
20 per cent. by the ashes in the tubes, making the available passage way only 4.4 square feet for a 100 horse-power boiler. It will be readily seen that when this space is divided into 68 parts (the number of the tubes), the flame cannot pass very far into the tubes before it will be extinguished, when combustion must cease.

In Fig. 1. the tubes in the Gill boiler are all shown having a thick scale formed inside of the tubes. By removing the caps at each end of the tubes, a scraper may be pushed through them and all the scale removed, making the boiler as efficient as when new. Should the scale be so hard as to resist the effects of the scraper, a quantity of caustic soda can be put into the boiler and boiled for several hours before removing the hand-hole caps; this will soften the scale so that it will no longer resist the scraper. This process is so simple and easily performed and without having to enter the furnace, that a good engineer will not allow his boilers to get into the condition shown in the figures. In ordinary practice it will be found that the removal of the lower course of caps and the caps in the mud drum will be all that is necessary for cleaning the boilers.

Fig. 2 shows the scale formed on the outside of all the tubes of a return tubular boiler and the passage way (for the steam and water) up through and between the tubes almost closed and the circulation of the water almost stopped. The efficiency of the heating surface is destroyed in proportion to the thickness of the scale.

The Stearns Manufacturing Co., of Erie, Pa., having long enjoyed a high reputation for manufacture of the best quality of other types of boilers, and being determined to keep abreast with the times, have secured the patents, patterns, drawings and good will of the inventor, Mr. John L. Gill, Jr., of Philadelphia, and also engaged his services to conduct the engineering and contracting part of the business.

DRY STEAM.



Among engineers we believe there is no diversity of opinion as to the value and advantage of dry, over wet steam. By moisture steam is rendered sluggish, and its elastic force diminished proportionate to the amount of saturation it contains. Water in steam is produced either from condensation incident to extended lines of steam pipes, or from boilers priming, a state of affairs often produced by forcing boilers to the full limit of their capacity, or from bad water used in them. The dangers attending the sudden carrying over of water from steam boilers are so strongly evidenced in the working of engine cylinders that it would seem in these days of high speed and small clearances that a device which, being connected into the steam pipe, will automatically separate the water, admitting only dry steam to the engine, is a most essential appliance to the completeness of a steam plant. It has been fully demonstrated that by mechanical action the end desired can be accomplished. The subject of mechanical steam separation has become of so much interest to the steam user that it was taken up last June at Sibley College, Cornell University, and a competitive test made with a view to determining the best methods of construction, manner of operation and the comparative efficiencies of the best forms of steam separators known to the market. The Hine eliminator, of which a sectional view of the horizontal style is here given, headed the list in the test, with the truly remarkable average of 98 7 10 per cent. dry steam, twelve distinct trials being made with steam in moisture, ranging from 10 to 33 per cent., which undoubtedly is as great as will ever be found in any practice. By referring to the sectional view the construction of the eliminator and its method of operation will be readily seen. A corrugated vertical diaphragm interposes between the inlet and outlet side. By force of the incoming current the steam is driven against the diaphragm, and by impinging the transverse corrugated surfaces the initial separation takes place before the turning of the steam into the outlet side. At a proper distance below the diaphragm are two converging disks B B, between which the water or other eliminated particles pass in a direct line into the chamber below, out of and away from the effects of the steam current, while the clear, dry steam, by its elastic nature, turns under the diaphragm, passes upward and out, being diverted from its course by an inward extending pipe at the immediate point of outlet. The Hine Eliminator Co., of 108 Liberty street, are the manufacturers, from whom all particulars can be had.

A GOOD OIL CUP AND A NEW OIL PUMP.

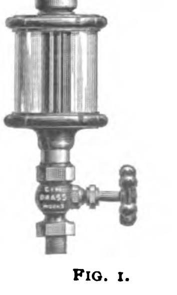


FIG. 1.

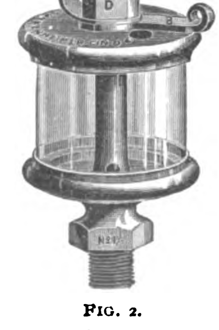


FIG. 2.

The Lunkenheimer glass body oil pump, Fig. 1, is easily filled and operated, and is intended to be used in connection with sight-feed lubricators on stationary engines. No large engine, especially an electric light engine, should be without a cup of this kind as an auxiliary to the sight-feed lubricator. Its use is understood by most engineers.

The Lunkenheimer "pioneer" slide top glass oil cup, Fig. 2, is especially adapted for traction engines. It is easily and quickly filled and regulated, and is the only slide top oil cup in the market that will not shake apart nor feed unset when placed on jarring machinery. It is for all engine bearings. This company has also a complete line of lubricators. glass cups, grease cups, etc. If you write for information, please mention the SCIENTIFIC MACHINIST.

A New Drill Press.

The writer recently saw in the shop of Dietz, Gang & Co., 56 and 58 Plum street, Cincinnati, O., a new patent drill press. It has many very interesting features, and is undoubtedly a great success, for there is a number, perhaps a dozen, in use already, and giving excellent satisfaction. Those desiring to get a first-class machine should write to them. The circulars are not yet printed, but the builders probably have some photographs mounted on cloth that can be sent to the address of any one who wishes to see what it is.

MR. MCKINNEY, of the Niles Tool Works, of Hamilton, O., started, on Feb. 1st, for a three months' trip to Europe. It is understood that it is entirely for relaxation. One having the responsibility of the management of two such large institutions as the Niles Tool Wooks and the Gordon Steam Pump Co. certainly needs to be released from business care once in a while.

HAVING put more matter in type than could be used, we are obliged to hold over Mr. Harrison's serial narrative, "A Set of Fine Tools."

World's Fair Notes.

Water for the Exposition grounds will be supplied from two pumping stations having a combined capacity of 64,000,000 gallons a day. The largest of the two has a capacity of 40,000,000 and constitutes the exhibit of the Worthington Pump Co, which puts in the entire plant, costing $250,000, free of expense to the Exposition.

The ceremonies attending the dedication of the Exposition buildings, October 11, 12 and 13, 1892, are to be very elaborate and impressive. The committee having the matter in hand will devote $300,000 to that purpose. It is expected that the President of the United States and his Cabinet, many of the Senators and Congressmen and Governors of the States, numerous representatives of foreign governments, and 10,000 militia and several thousand regulars will be present. A dedication ode and marches, written for the occasion, will be rendered with full choral and orchestral accompaniment. Patriotic and other music, a dedicatory oration, a pageant of symbolical floats representing the "Procession of the Centuries," and magnificent displays of fireworks will be among the chief features of the programme.

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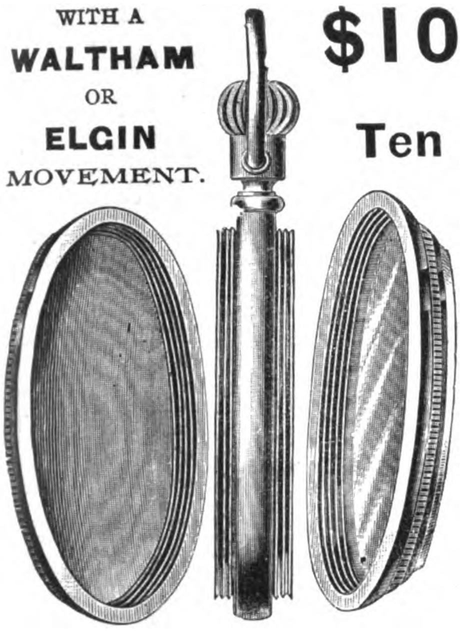

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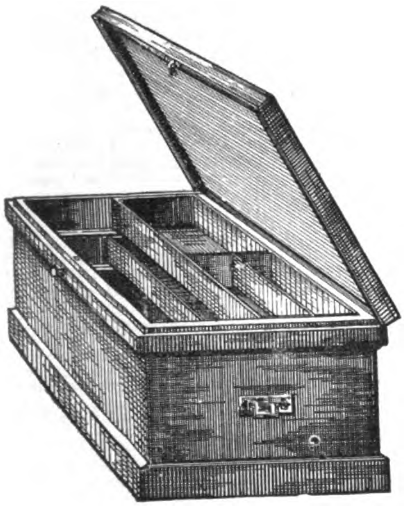

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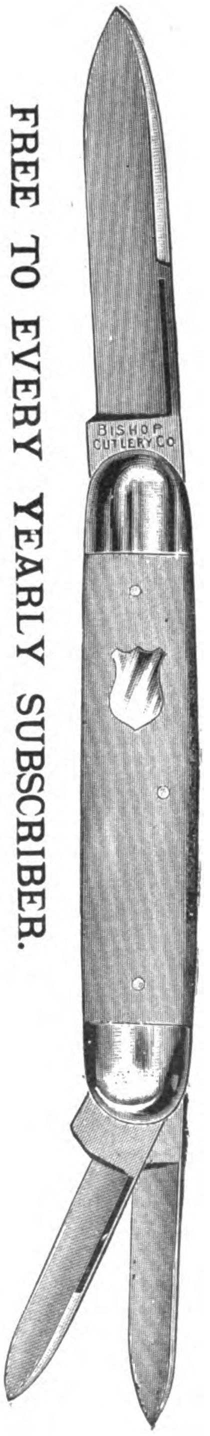

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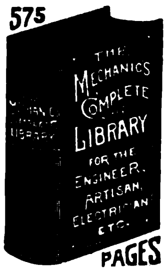

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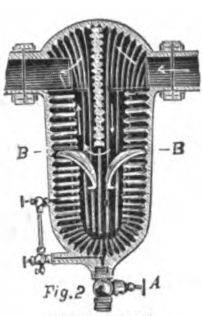

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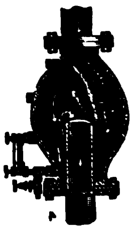

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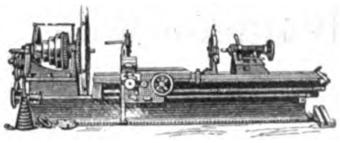

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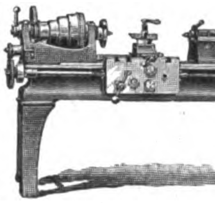

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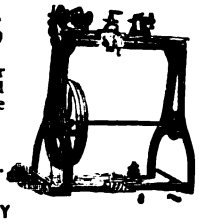

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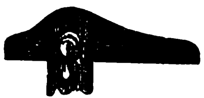

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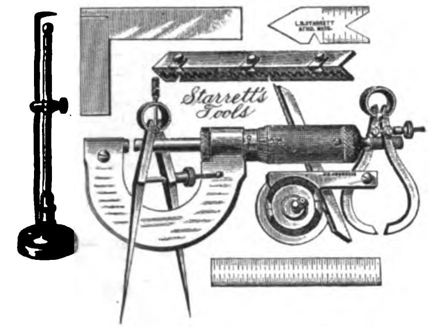

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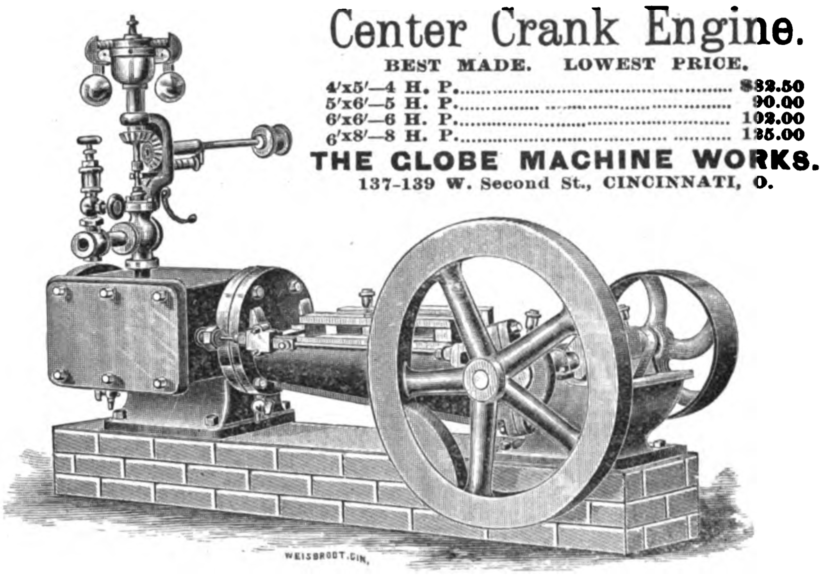
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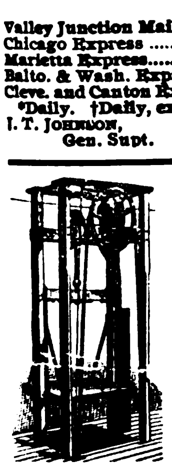

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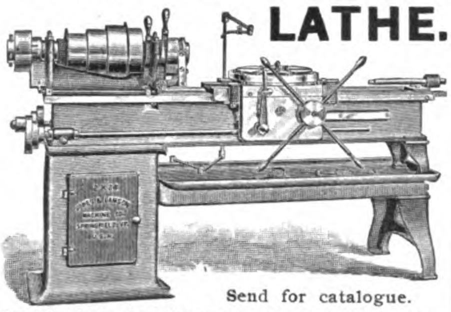

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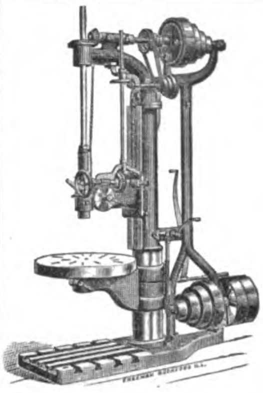

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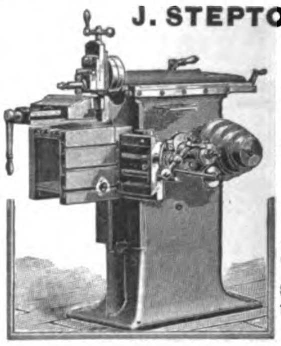

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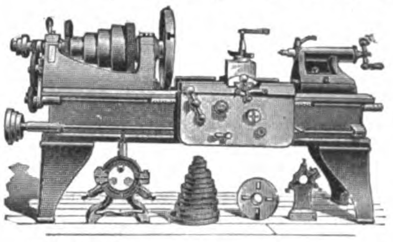

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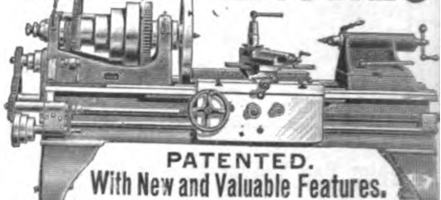

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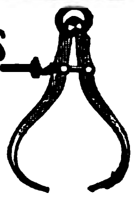

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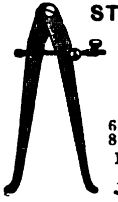

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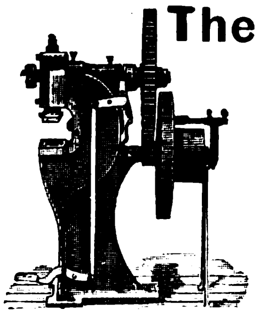

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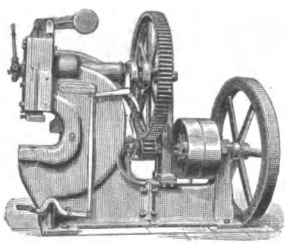

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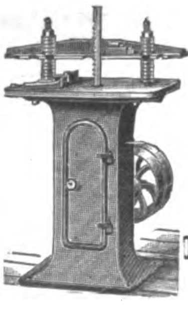

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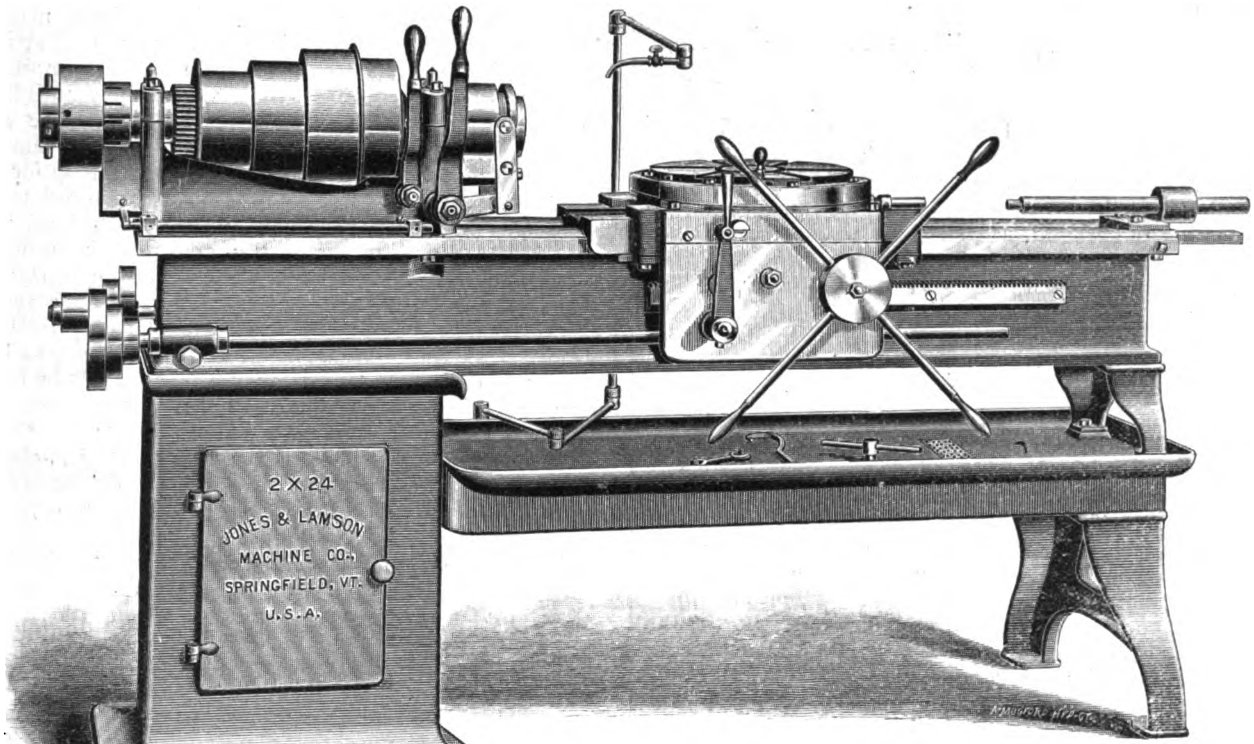
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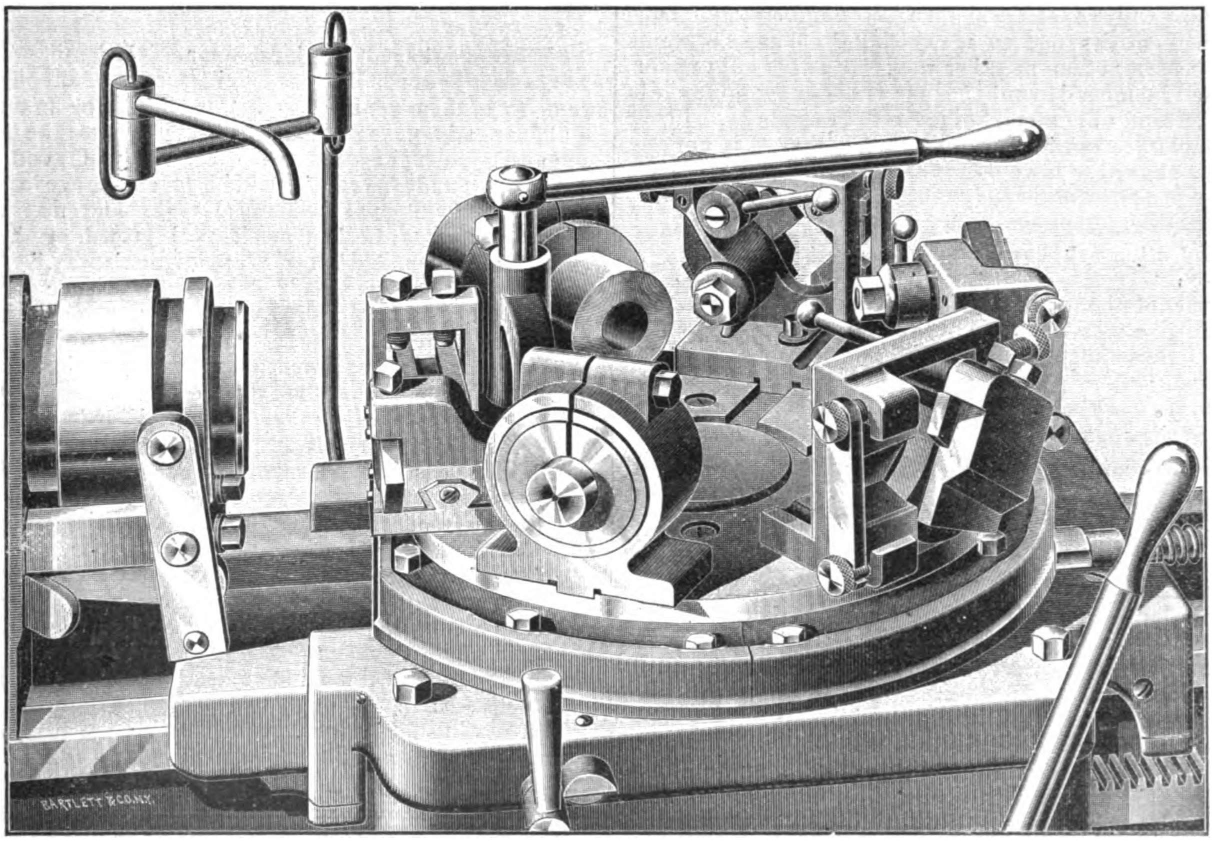

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If the work is slender, the back-rest must procede the cutter and take

(Continued on page 4.)

Practical Letters.

Is the Eccentric Patented?

EDITOR SCIENTIFIC MACHINIST:

I wish to ask, can anyone reading the SCIENTIEIC MACHINIST inform me whether the eccentric was ever patented? If so, when, and in what country, and by whom? WM. H. B.

Where Iron Balls are Made.

EDITOR SCIENTIFIC MACHINIST:

In your answer to question No. 318, of your February 1st issue, you say that you do not know of anyone making iron balls. I will refer you to the Simonds Rolling Mill Co., of Fitchburg, Mass. They have perfected a rolling mill for the rapid turning out of balls for friction or ball bearings, anything from ⅛" to 1½". They have a machine for grinding the same. I have seen them roll 1" balls that would not vary .005 of an inch by micrometer calipers. N. C. MERRIAM.

A Question for Scientists.

EDITOR SCIENTIFIC MACHINIST:

Would be pleased if some of your readers can give me the information I want. In the early settling of Texas there was a great amount of gold and silver buried in that State that has never been found. Being raised near the locality of several deposits, I have been experimenting for several years to make an instrument that would work to gold or silver buried under the ground, but have failed to a great extent. Now there is no question in my mind but there can be made an instrument that will work to gold or silver under the ground, as well as on top of the ground. I have two small instruments, which were made for the purpose, but they are not what I want. I will be much pleased to get any information on the subject. A. L. S.

The Practical Man.

EDITOR SCIENTIFIC MACHINIST:

I notice that a good many of the correspondents of your paper, in asking questions, request that the answers be given "in a simple way," "without algebra," or "with no college arithmetic," as one puts it. These are indications that the majority of mechanics do not readily understand mathematics beyond fractions. This can be the only reason why they do not wish to come into contact with this science, for if they understood mathematics fairly well they would see the great utility of such knowledge, and would want to know more. If an answer to a question contained some figures they did not understand they would find out, and not be afraid of the mental work necessary to this solution of the puzzle.

Now, I may be in the minority. I suppose I am. But it is a fact that to learn enough of mathematics to understand all the problems in the various hand-books and be able to figure out, algebraically, the usual computations and calculations in engineering and construction, is not as difficult as generally supposed, and when undertood even moderately, obviates much difficulty.

It is a great mistake to suppose that such information is not necessary to a practical man. How will the practical man ascertain essential facts without applying the mathematics that so many shun? What he wants and must know can be learned in no other way. If he does not understand the process himself he must depend on some one else or guess. Is it practical to be dependent on others for accurate calculations, without which correct work cannot be done? It seems to me that it is entirely impractical. Would be pleased to have others express their views.

V. L. STOCTON.

Fitting a Loose Coupling.

EDITOR SCIENTIFIC MACHINIST:

I saw in your issue of the 15th inst an article on prick-punching a misfit. Now, I wish to give your readers a little of my experience in that line. I know from experience that accidents will happen in the best regulated families (or shops).

In 1882 I had charge of a large machine shop that employed about 120 men. We built various kinds of machinery, such as engines, rubber machines and elevators. We had at one time on the floor a large double-worm gear elevator for one of the Brooklyn City horse railway companies, capable of taking up their heavy cars. In the mechanism of it, we had a long shaft, about 3½" diameter, which was coupled together in the center. Now, it was of the utmost importance that this coupling should be fitted to a nicety, as the whole strain had a tendency to pull it apart. I had one of my best men on the job, but he slipped up and made a very loose fit. He came to me with a very long face, and told me of his trouble, and I made an examination of it, and I ordered him to take it to the blacksmith shop and have a new end welded on.

But in thinking the matter over I thought I might save that trouble and expense by expanding the end of the shaft. So I followed it in to the blacksmith shop, and told the foreman to heat it to a nice cherry-red, and be very careful not to scale it, and then cool it off as quick as he could. He did as directed, and we brought out the coupling to try it on, but it was no go, and we had to put it into the lathe and dress it up before we could get it on. But it was a short and quick way of making a first-class job.

It is a well-known fact of mechanics, that heat expands iron, and that when cooled off it will not return to its natural size, and I think that if friend Cook had done as I did, he would have had a fit that he would have had no doubts about. J. M. C.

IN AND ABOUT THE SHOP.

I often see in the trade papers of the day the question asked by young men, "Where shall I go to learn my trade to the best advantage?" To the boy or young man who is in earnest, it is a vital and all-important question, but to the one who has to learn, or go to school, and who chooses the shop rather than the school-room, it does not make any material difference where he goes, so far as he is concerned. And so far as the rest of human race is concerned, I don't think any of us care. At least I don't, so long as he takes care to keep away from my shop.

To the boy who is interested in mechanical work, and whose talents naturally develop in that direction, I would suggest that his time of apprenticeship be served in a small shop, for the following reasons: First, in the small shop there is generally but one "cub" or apprentice at a time, and he grows to have more of an interest in the place than if it was large and employing many hands. Second, not having any other boy to play with or to divert his mind from the regular work of the shop, he will get along faster and will grow to be more of a man in his thoughts regarding the reasons for the ways and methods for doing things. Third, he will get greater opportunities for handling the various machines and tools in the shop, and thinking out ways and means for doing the many things that always come up in practice. Fourth, he will come in closer contact with the proprietor, and from that contact retain many valuable business principles that will be of inestimable aid to him in after life. Fifth, he will more readily receive information and instruction from the journeymen who, as a general thing, too, give it in such a manner that incidents and references are always brought forward to make an impression on the mind. Sixth, but pshaw, I could give reasons from now until breakfast and not be half through, and all based on my own experience and from personal knowledge of others, and not simply airy visions dreamed out in my office.

The principal thing to attend to in searching for the shop in which you are to learn your trade is to see that the proprietor as well as the employes has a habit of putting tools, jigs, hammers and other things he uses back in their proper places, instead of slinging them under the benches or leaving them on the planers or lathes for the workmen to throw down. If the shop has no system or discipline in it, keep away from it and look further. Such a shop has no respect for the proprietor, who has none for his men, while they have still less for either shop or boss, and if you are unfortunate enough to start in such a place it will be but a short time until your own desires and ambitions will have been tossed under the bench of misfits and carelessness and you will have become a "slipshod workman," always complaining because you can not get first-class pay, and never knowing that it is because you have blossomed forth an undisciplined, cannibalistic mechanic, whose sole aim in life is to destroy the beautiful in shop arangement.

In the large shop where there are several "cubs," there are too many contentions, and the rivalry is too great. You may learn how to fight for your rights and how to get ahead of the other fellow, but you won't get much permanent mechanics hammered into your cranium.

In the large shops of the present time, everything is tending to piece-work, and when an apprentice gets started nicely on a piece-work job, the glitter of the sudden increase in his weekly stipend is very apt to blind his eyes to the original purpose for which he began, he finds in the end that instead of coming out of his time a finished journeyman, he is a pure and simple "machine tender," able to do any kind of a job that comes along to the machine that he is in charge of, provided the brains of some one else are used to assume all responsibility, and to explain to him how it must be done.

There are lots of this kind of material floating around from shop to shop, and it is worth about one dollar per day, although I do believe there are many of them getting two dollars for staying in the shop ten hours. I would say, take the small shop, it is more homelike and social, and there are more opportunities for the quiet study of good systematic methods, kinks and "trade secrets," tending to encourage a desire after working hours for study of good mechanical works and magazines, which, if kept up, will give good, healthy mechanical growth of the mind, and prevent falling into the one old rut of "grandfather's way."

Thus you will eventually absorb the "science of mechanics," which is really the combination of theory and practice, or the true reason why and the remedy therefor. Never allow anyone to instil into your mind that theory is of much less importance than practice, and that a "practical" man can get along better than the theoretical one, for your own observation will show you that the so-called "practical" man chops things all to pieces, and spoils about one-half and then by bull-headed luck sometimes succeeds, but it has cost considerable, while the man who has stopped long enough to theorize on the work gets it done easy. No one theorizes more than the really practical man and he is reasoning with himself all the time, with the result of success in practice.

A man's theory that he could do quite a good business carting goods around town for the merchants, if he had a good, strong, gaudily-painted cart was a good one, but it would have been a total failure if he had not combined a good, practical mule to go on the business end of the cart, and so would his practical mule have been as bad a failure without the theoretically colored cart. They both go together to bring success, and I think the "little old shop" gives the apprentice the best opportunities to drive them both together under the best conditions, *if he tries.*

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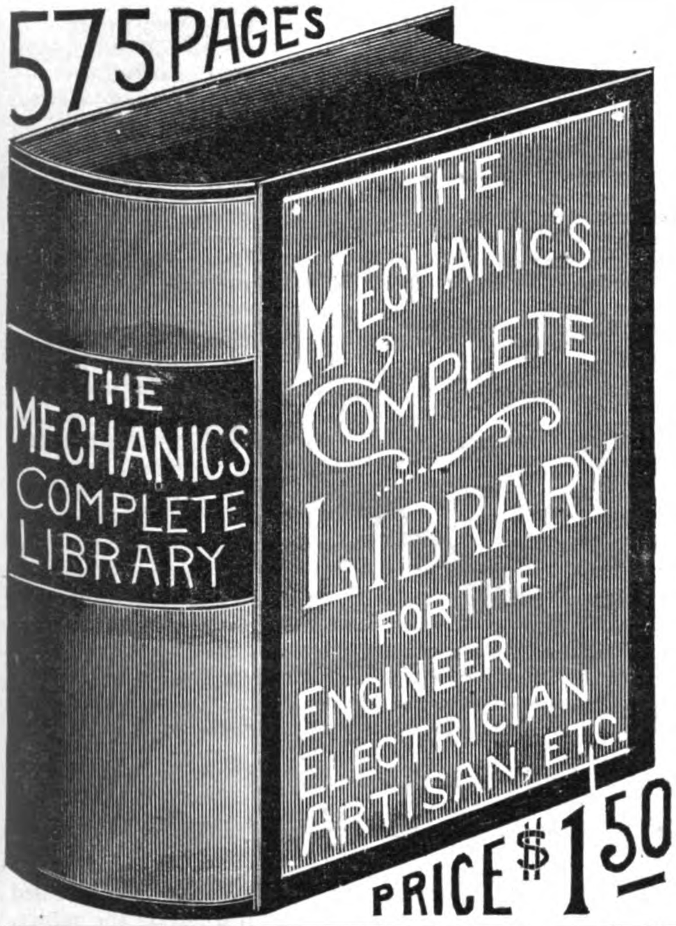
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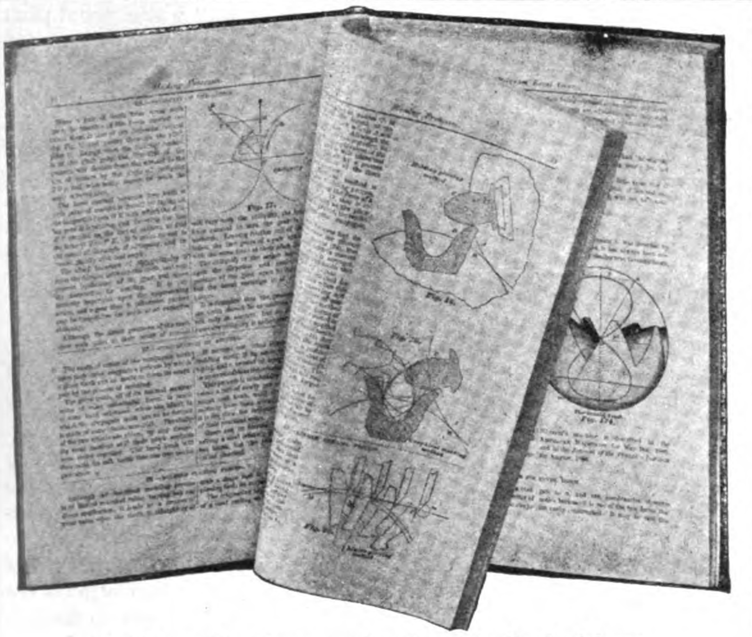

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THE MECHANIC'S COMPLETE LIBRARY Is about double the size of the cut in this page. It has 575 pages and some 250 engravings, and treats of almost every subject, like the hand-books of Haswell, Trautwine, Nystrom and others. Immense editions have been sold. It has a vast quantity of matter, and is a very cheap book for its price—$1.50. **With every copy is given free a complete working chart for setting gear teeth.** We can not give a more detailed description, but will, as stated below, refund the money to any one who may think the paper and book not worth $3.

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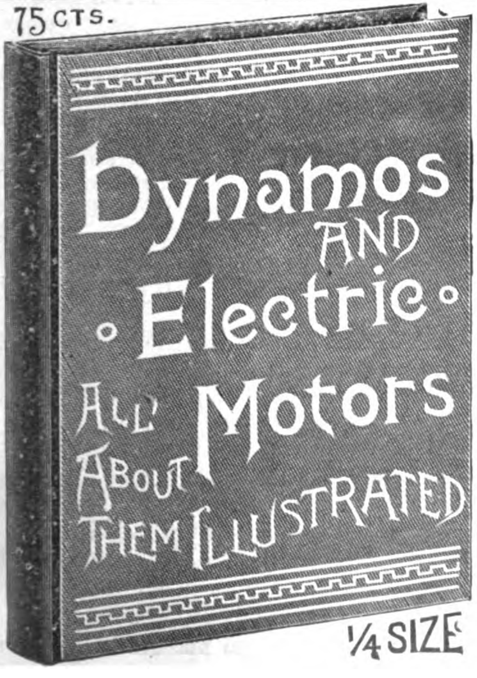
DYNAMOS AND ELECTRIC MOTORS Is by Edward Trevert, and is in every respect a first class work. It is just 4 times the size of the accompanying cut.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PUBLISHED ON THE 1ST AND 15TH OF EVERY MONTH.
Address all communications to

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ATWATER BUILDING, CLEVELAND, O.

Subscription Price in United States and Canada, in advance.................................. $1.50 per year
Subscription Price to Foreign Countries, in advance.................................. $2.00 per year
Advertising Rates: 12 cents per agate line, each insertion.

The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience or experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, MARCH 1, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

A HISTORY OF MANUFACTURING IN THE WESTERN RESERVE.

Some years ago, the editor of this journal procured considerable material bearing upon the inception and development of manufacturing in Cleveland and Ohio. It has not been used. A few months ago we decided to utilize it in a special edition devoted to the history of those industries in the Western Reserve. It will appear in the form of a special supplement to the SCIENTIFIC MACHINIST, and will be entitled "History of Manufacturing in the Western Reserve."

We are not given to dilating on our own merits. It is not "puffing" ourselves, however, to assert, what is everywhere acknowledged, that whatever we do is well done. Our paper is first class, and our special supplement will be likewise. It will be a literary work, will contain no advertisements nor any matter inconsistent with a legitimate work of history. It will be sold with and without covers. The unbound copies will be 25 cents, and those in leather binding $3. The newsdealers will be the only authorized agents to take subscriptions.

We do not expect to make money on this work. It would be impossible to publish a *creditable* history of manufacturing in this or any other section, and realize much money on it. But we will add a volume to local literature that will take its place as a standard work.

AN OLD EDITOR RETIRES.

Mr. W. M. Day, after a continuous service in the editorial harness of over twenty years has retired from the *Iron Trade Review*, yielding the chair to Mr. A. J. Findley. Mr. Day has, by his eminent fitness and fairness gained a wide reputation. It is not uncomplimentary to say of his successor that he will do very well to keep up the present standard of the editorship of that journal.

2 x 24 FLAT TURRET LATHE.

(Continued from first page.)

bearing on the surface produced by the first cut which traveled from the chuck. All cuts on short work are taken traveling toward the chuck, and on account of the perfection in design of this machine back-rests are not required on short work. We can not describe the different parts, as space will not permit, but a postal card sent to the builders, the Jones & Lamson Machine Co., Springfield, Vt., will secure for any one a copy of an elegant little work, entitled "Rapid Lathe Work by a New Method," which will give all the interesting details.

THE Hine Eliminator Co., of New York, report an active business since the holidays. Among the Western shipments of their eliminator for both oil extraction from exhaust, and water separator from live steam, are the Michigan State University, Ann Arbor, three; Grace Hospital, Commercial Milling Co. and Lane Bros., Detroit, Mich.; F. Schunk & Sons (2nd order), Wheeling, W. Va.; Fairbanks, Morse & Co., St. Paul, Minn.; Gordon Steam Pump Co., Hamilton, O.; Austin (Tex.) Water, Light & Power Co.; Battle Creek and Jackson (Mich.) Electric Light Co.s; E. C. Atkins & Co., Indianapolis, Ind.; Watertown (N. Y.) Steam Engine Co., L. H. Prentice Co., Chicago. It is evident that the high merit of this device as it becomes known to the steam user is being appreciated.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(332.) John L. Fead, Lexington, Mich., writes: 1. "Since we have put up a new smoke stack, two years ago, we have had considerable trouble by the crab or hand hole on our boiler burning out. It melts down. We have to put in a new one every year. Will you tell me the cause, and remedy? The space between the boiler and the wall on the back end is two feet. The bridge wall is the proper height, and the air space under the boiler, back of the bridge wall, is lower than the grates, about three feet deep from the bridge wall back to the wall. P. S.—Our boiler is 14 feet long, 40" diameter and 3" tubular flues. 2. Of late years we have had considerable trouble obtaining our water supply. We are located about 300 feet from the water edge of Lake Huron. We now obtain our water supply from a tank sunk in the sand about 20 feet from the water edge, the water soaking through from the lake. We get plenty of water but it is rusty and not suitable for our business. If we could go out in the lake about 150 or 200 feet we could get a supply of clear water. The question is, How can we put pipes out there, and anchor them to stay so that the action of the water will not displace the pipes? A reply will be appreciated." *A.*—1. Cover the crab with fire clay after cleaning out the boiler, and you will have no trouble by its burning off. 2. You can run a pipe out into the lake, on or near the bottom, place an elbow and stand pipe on outer end, let it extend up a sufficient distance to keep the sand out, then drive a pile down and lash the upright pipe to it.

(333.) G. H. M——s, Evanston, Ill., writes: "The condensed steam soaks through our brick wall, and shows up white on the outside. How can it be prevented?" *A.*—To make a brick wall water proof paint it when dry with one pound of soap dissolved in 1½ gallons of water, and after this is thoroughly dry paint again with a solution of 1 pound of alum in 8 gallons of water, repeat this operation four times, when the brick will be found to resist the action of water.

(334.) H. E. J——n, New Lisbon, N. Y., writes: "Can you tell me how to remove tin coating from iron?" *A.*—Immerse the article in a solution of blue vitriol. To remove tin from plates without acid, boil the scrap tin with soda lye in presence of litharge.

(335.) J. T. A., Detroit, Mich., writes: "Will you, through your valuable paper, favor me with a correct answer to the following: 'Does the action of the engines inside a single screw steamer have a tendency to heel the boat slightly in opposite direction to which the screw itself is running? I am not a seaman, but my mechanical knowledge makes me think it does, although all the shipbuilders I have asked say it does not." *A.*—No It does not.

(336.) N. J., Petoskey, Mich., asks: "Can you give me a rule for figuring the material, or feet, in round timber, for lumber?" *A.*—To ascertain the number of cubic feet in round timber, find the average circumference by adding the circumference of the larger and smaller ends, and dividing by 2. Then multiply the square of one-fouth of this average circumference by the length in feet, and the result gives four-fifths of the real contents in cubic feet, one-fifth being customarily allowed to the purchaser for waste in sawing.

(337.) Albert Shaw, Salem, Mass., writes: "What is the actual atmospheric pressure per square foot and per inch?" *A.*—The ordinary pressure of the atmosphere on the surface of the earth is 2,168 pounds to each square foot, or a fraction less than 15 pounds to each square inch, equal to 30 perpendicular inches of mercury or 34½ feet of water.

(338.) Jimmy Nelson, Tarrytown, N. Y., asks: "What is the size of the largest steam hammer in the world?" *A.*—Probably the largest steam hammer in the world is at Pittsburgh, Pa. It strikes a blow of 200 tons. The anvil block is a solid cube twelve feet square and weighs 180 tons. It was cast upon the foundation it now rests on, and it took the contents of six cupolas to make the block. It took six months for the anvil to cool, so that the sand could be dug away from it and then it could not be touched by the workmen.

(339.) C. V. Rosser, Troy, N. Y., asks: 1. "What is the explosive force per square inch of gunpowder?" *A.*—The explosive force of confined gunpowder is 6½ tons to the square inch. 2. "What is the name of the largest tunnel in the world?" *A.*—The largest tunnel, we think, is the St. Gothard, on the line between Luçerne and Milan. The summit of the tunnel is 900 feet below the surface at Andermat. It is 26½ feet wide, 18 feet 10" high.

(340.) D. L. C., New Philadelphia, O., asks: "Where, and by what firm are those wooden horses manufactured that are used on the so called merry-go-arounds or swings." *A.*—We think they are made by a concern in Toledo, O. Probably some of our subscribers in that city can inform the inquirer. If so they will oblige us as well as the querist.

☞Readers are cordially invited to send us any questions, comments, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—ED.

A SCIENTIFIC journal states that a little sugar put on the hands with soap will greatly increase its cleansing power.

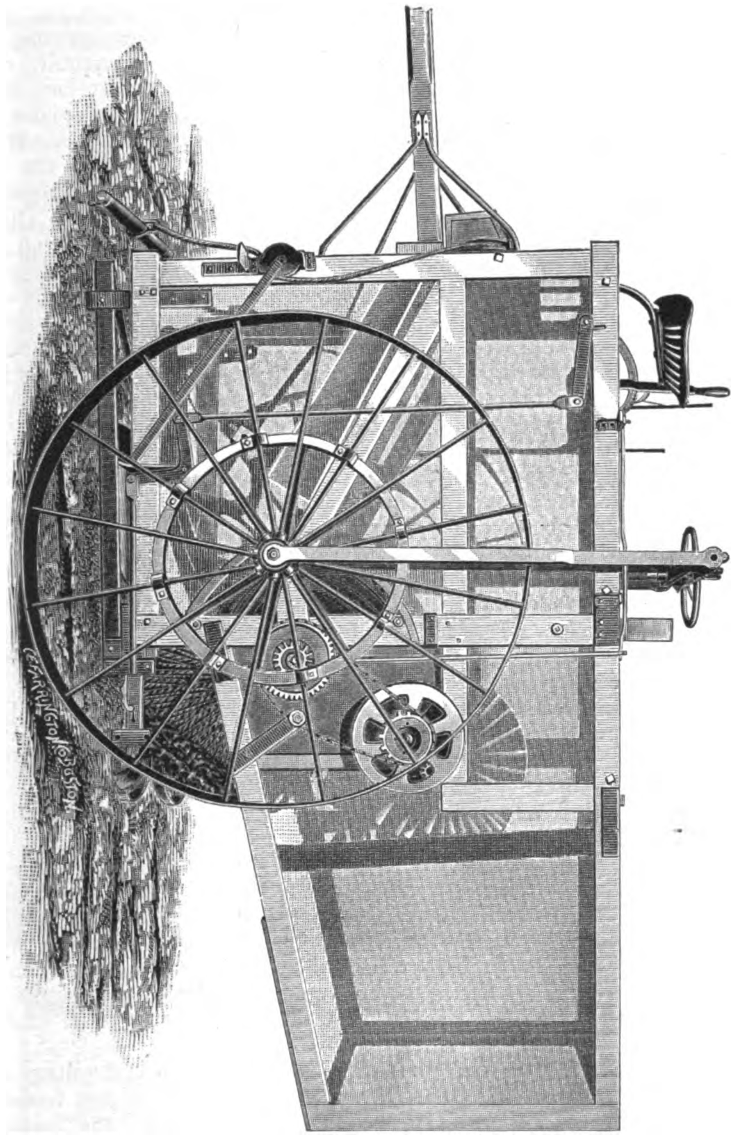
THE LONE STAR COTTON PICKER.

It is hard to give a clear idea of the details of its construction from the cut detail drawings are needed. The machine represented by this cut is a new cotton picker. It is mounted on two wheels, and drawn by mules directly over the row to be picked. The plants, if tall, being slightly bent to permit the cylinders to pass over. Spindles revolving with great rapidity are then thrust between the branches of the plant permeating every part. The spindles are furnished with brush-like surfaces, properly guarded, that engage the fibrous cotton, leaving the unopened bells, blooms and leaves uninjured.

The spindles in series of nine each project from sixteen small cylinders, which revolve around a common centre, and at each revolution present the spindles, after they emerge from the plant loaded, to rapidly revolving brushes which clean them of cotton, an operation similar to the cleaning of gin saws.

The cotton is thrown by centrifugal force to the rear into the receptacle, which has a capacity of about 75 pounds, and is made of made of heavy wire netting, allowing the dust and dirt to escape but retaining the fibre.

Each cylinder has an independent motion, equal to about one-half a revolution on its own axis, which motion causes the spindles to remain relatively stationary to the plant while picking, and to enter and emerge from among the branches with the least possible disturbance, no combing or raking motion being produced.



The machine is the invention of Angus Campbell, and is made by the Lone Star Cotton Picking Machine Co., Waco, Tex.

THE ARMSTRONG TOOL HOLDER.

This is for general use in lathe, shaper and planer. The rapidly increasing use of "self-hardening" steel for turning and shaping metals, its high price and the difficulty found in forging it, etc., renders a tool holder an almost imperative necessity. A tool holder should combine strength, simplicity, and cheap cutters. The clearance should be easily changed, and the top rake should be sufficient for the clean cutting of wrought iron and steel. All of these and many other valuable features are combined in a device here represented.

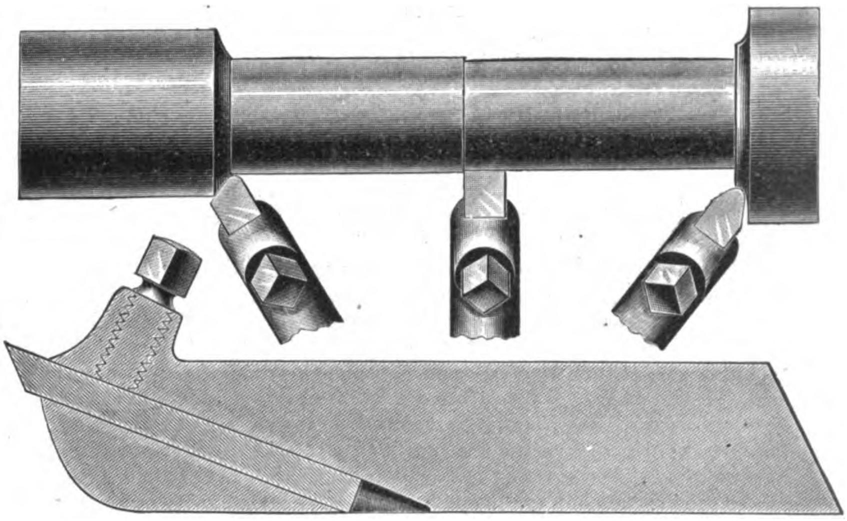
By its use forging and tempering are entirely dispensed with, and grinding is reduced to a minimum. The points can be ground to any desired shape or clearance. It is of a handy length, and the point always keeps at the same height. It will work either right or left hand, and as there are no side projections it can be used close into a corner. The rake of the cutter is such that it takes a clean curling chip from wrought iron or steel, *no top grinding being necessary*. There is absolutely no slip to the cutter, it is supported directly under the strain of the cut, and will do as heavy work as any forged tool of same size. One pound of tool steel used in this holder equals, it is claimed, ten pounds in the ordinary tool.

The holder is drop-forged of steel and case-hardened. The top and bottom are planed square with the sides. The hole for the reception of the cutters is drilled and squared from the solid, insuring a straight and true seat. The set screw is tool steel, with tempered point.

The cutters are made of superior self-hardening steel, and the points ground to shape. This steel is superior in the fact that it will keep a finer edge than any other self-hardening steel made. With it speeds and feeds can be greatly increased. Whilst hot this steel should be kept from water.

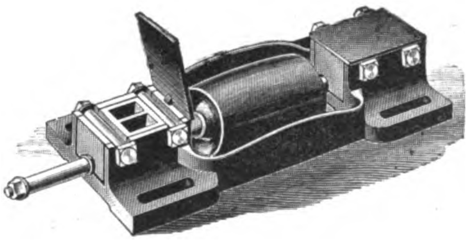
The saving in time, money, labor and annoyance, cannot be over estimated. It is common sense and practical in every particular and with ordinary use and abuse will last a lifetime.

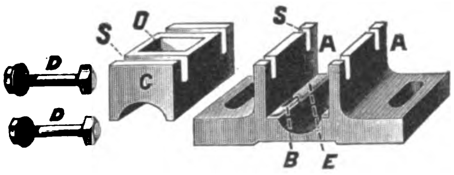
It has been used and, after a thorough trial, endorsed by the following well known concerns: Illinois Steel Co., The Lodge & Davis Machine Tool Co., Crane Co., Buckeye Engine Co., McCormick Harvesting Machine Co., Wm. Deering & Co. (Reaper Works), The Westinghouse Machine Co., Illinois Central R. R. Shops, Cleveland Iron Mining Co., The Snow Steam Pump Works, Bass Foundry & Machine Works, Wheeler & Tappan Co.



We have before us some remarkably convincing testimonials from well known concerns. It will certainly pay any machine shop to send a trial order. For prices and fuller particulars, address, Armstrong Bros. Tool Co., 78 Edgewood ave., Chicago, Ill. A prompt reply will be insured by mentioning this paper.

A NEW JOURNAL BOX.





Briefly stated, the improvements represented by the accompanying cuts, showing a new patent journal box, consist in making the walls A A of the casting to extend up to the height of the top of the cap box C. These walls being planed through longitudinally the cap is neatly fitted between them. To secure the upper or cap box, instead of using bolts or screws to draw it down in the direction of the shaft, it is clamped in position by bolt D D, laid in grooves S, cut transversely to the axis of the shaft across the top of the cap and through the side walls. By tightening these bolts the walls are drawn together, clamping the cap box firmly between them. A large oil chamber D is provided in the upper cap. The packing of paper or wood usually found in the ordinary journal box is entirely dispensed with here, thus leaving room for a strip of wicking E, one edge of which comes in contact with the shaft for lubrication, and the other edge connects with an oil well B. Channels are provided in the casting for carrying any excess of oil back to the well. The Pennsylvania Machine Co., Limited, Philadelphia, Pa., are the manufacturers, and will give any additional information desired.

THE Forrest Silver Bronze Packing Co. have just received orders from the Westinghouse Air Brake Co., the New York Biscuit Co., Cowles Engineering Co., A. F. Bartlett & Co., New York, New Haven & Hartford Railway Co., the Brooklyn Bridge, Brooklyn Brass & Copper Co., Frontier Iron Co., Lehigh Valley Railway Co., Albany Day Line, Rome Brass & Copper Works, Municipal Electric Light, Lake Erie Engineering Works, Buffalo; P. Smit, Jr., Rotterdam, Holland; Social Manufacturing Co., the Watts-Campbell Engine, the Edison Electric Illuminating Co., the New York, Lake Erie & Western Railway Co., and a long list of others which gives an idea of the people for whom they are doing work, including an order from the United States revenue ship "Winona."

THE extent to which our commercial relations with Chili can be promoted, is the subject of an article which Wm. Eleroy Curtis, Chief of the Bureau of American Republics, has written for the March number of the *North American Review*.

A SUGAR 20 times sweeter than beet sugar has been extracted from cotton-seed meal.

ELECTRIC METAL WORKING.

The subject of utilizing electricity in the working of metals has attracted more general attention than any other department of electrical development since the introduction of the telephone. It has advanced much more rapidly than was anticipated, and it may safely be assumed from the many industries in which it has acquired prominence that it will occupy a most important position. Metal workers generally will be interested in the subjoined description of the electric metal woking machines, the principles governing their construction and operation, and the advancement made in the application, by S. D. V. Burr in *Iron Age*, from which the accompanying cuts were reproduced by the *Western Electrician*.

The art of electrically working metals was discovered several years ago by Prof. Elihu Thomson, while lecturing before the Franklin Institute of Philadelphia, by the accidental melting together of the coarse wires of an induction coil. From this simple incident, and the train of experiments and research following quickly in its wake, has come the present development of the art.

The first machine placed in commercial operation was in July, 1888, at the wire works of John A. Roebling's Sons Co., Trenton, N. J. This machine has since been in almost constant operation, much of the time night as well as day. Other machines have been added to the plant, which now consists of seven welders, adapted for various classes of wire and similar work.

Machines are in practical operation at the present time, turning out work in brass and copper, ranging from No. 16 wire guage up to rods having a cross sectional area of three square inches. In steel and iron the section varies from No. 16 wire guage to a sectional area of 8¼ square inches. Experimentally, a wire $\frac{2}{100}$ inch in diameter has been welded, and, as far as the large areas are concerned, it depends more on the demand than on any limitation there may be to the process. The greatest trouble experienced in the welding of extremely fine wire is the difficulty of maintaining the abutting ends in contact. This, as it will be seen, is a job requiring extreme delicacy and one in which the wires are very apt to slip by one another. Dissimilar metals are easily united, such joints having been made between round bars of iron and brass of a diameter of two inches, and a vast variety of smaller work has been accomplished.

From the very first the Navy Department has taken the greatest interest in the electric welding process. In February, 1890, a board consisting of four naval officers convened at Boston under orders of the Secretary of the Navy to visit the works and investigate the process. A most favorable report was made recommending the general adoption of the machines both on board ships of war, and in the navy yards.

In the manufacture of carriages, wagons, etc., the process has proved of special advantage, and in some of the largest works of this character the old-time forge and hand work have been entirely superseded by electric welders. The construction of these machines and the demand they directly created in their own manufacture tended to solve some problems in engineering, reflecting the greatest credit upon those who had the work in hand. In the construction of large universal machines castings of copper have been required larger than ever before demanded for electrical purposes. Several such castings are now in the works, weighing from 1,200 pounds to 1,500 pounds each. The welding machines have been received with the greatest favor abroad.

The following list comprises the metals, alloys and combinations which have been so far actually welded with success by the electric current:

METALS.

Wrought iron.
Cast iron.
Malleable iron.
Wrought copper.
Cast copper.
Lead.
Tin.
Zinc.
Antimony.
Cobalt.
Nickel.
Bismuth.
Aluminum.
Silver.
Platinum.
Gold (pure.)
Manganese.
Magnesium.

ALLOYS.

Various grades of tool steel.
Various grades of mild steel.
Steel castings.
Chrome steel.
Mushet steel.
Stubs steel.
Crescent steel.
Bessemer steel.
Cast brass.
Gun metal.
Brass composition.
Fuse metal.
Type metal.
Solder metal.
German silver.
Aluminum alloyed with iron.
Aluminum brass.
Aluminum bronze.
Phosphor bronze.
Silicon bronze.
Coin silver.
Various grades of gold.

COMBINATIONS.

Copper to brass.
Copper to wrought iron.
Copper to German silver.
Copper to gold.
Copper to silver.
Brass to wrought iron.
Brass to cast iron.
Tin to zinc.
Tin to brass.
Brass to German silver.
Brass to tin.
Brass to mild steel.
Wrought iron to cast iron.
Wrought iron to cast steel.
Wrought iron to mild steel.
Wrought iron to tool steel.
Gold to German silver.
Gold to silver.
Gold to platinum.
Silver to platinum.
Wrought iron to mushet steel.
Wrought iron to stubs steel.
Wrought iron to Crescent steel.
Wrought iron to cast brass.
Wrought iron to German silver.
Wrought iron to nickel.
Tin to lead.

Glancing through this list, it will be noticed that there are many metals, such as aluminum, lead, zinc, copper, etc., which have hitherto resisted all attempts to weld them, or when, welded, have proved to be exceeding difficult to handle.

A further application—not of the electric welding process, but a direct outcome of the work performed—is that of electric brazing and the bending and upsetting of metals. Experiments made toward perfecting the electric welding process early showed that metals could be locally heated, no matter what their shape, and could then be treated in precisely the same way as if they had been heated in the fire. This branch has been developed into an important industry, and we now find concerns utilizing the electric current for making difficult shapes, and for drawing and upsetting.

An electric welding machine requires a current of extremely low voltage and great quantity, this being what is known as the heating current. Its electromotive force being so insignificant, in the largest machines being only about one volt, its power to overcome resistance is extremely slight, while at the same time its power for generating heat in the material it is passing through is augmented.

It is evident that the slight resistance created at the point of contact of the two pieces to be welded generates heat. The phenomenom here is precisely similar to that taking place in the incandescent and arc lights, where in the former the resistance of the carbon filament causes the raising of the filament to incandescence, while in the latter case the distance between the carbon points produces the arc. It is further obvious that this resistance, supposing the pieces to be welded to be in metallic centact, varies directly as the conductivity of the material. It therefore becomes necessary, even in the welding of sections of wire of the same size but of different materials or composition, to vary the strength of the current.

The machine itself, by means of a transformer, changes the electric current to one of low voltage. Consequently it is essential to regulate the strength of the current by means independent of the machine. The rheostat was first employed, but as it introduced a resistance which merely served to reduce the current without any compensating work, it was wasteful. This is now formed by a reaction coil or "kicker," as it is familiarly called, the invention of H. Lemp. This consists of a ring of laminated iron, one portion of which, about one-sixth, is reduced in section to receive a coil of wire through which the current from the dynamo passes. Mounted upon a shaft placed in the center of the ring is a hood of thick copper covering the face and two sides of the ring for a distance about equal to that occupied by the coil. When this hood, which can be moved to any part of ring by a handle, is diametrically opposite the coil, the reaction in the coil is maximum and the current is reduced to the minimum. When the hood covers the coil the reverse takes place. By placing the hood at the proper intermediate point, the desired current is produced. Should a short circuit occur when the hood is near or over the coil, the increased current would throw it back, thereby bringing the coil into action, and preventing damage. Hence the name "kicker."

Electric welding has been performed by means of the continuous current, by secondary batteries, and also by unipolar machines, but the most favorable results have been obtained from the employment of the alternating current. This is due to the fact that this current can be economically produced in large volume, and easily transformed so as to have low electromotive force or voltage. The current, further than this, can be readily controlled, and can be distributed at high pressure over conductors of small sections, thus permitting its transmission to a distance without much loss of energy. One of the principal obstacles arising with the use of the continuous current is that the heating will not take place with absolute uniformity in the two abutting ends. As has been observed in the case of the carbons in an arc light, the current in its passage conveys the small incandescent particles of carbon from one carbon to the other, and when the same current is applied to the heating of two pieces of metal the current acts in precisely the same way, and one is heated to a greater extent than the other.

The most convenient method of obtaining this low voltage current depends upon induction. The principle is the same as that found in the induction coil of an ordinary secondary battery, but the construction or arrangement of the two coils is reversed. An iron core is provided, and around this is a wire coil carrying the dynamo current. But the secondary coil, instead of being of very fine wire and correspondingly high resistance, as in the common induction coil, consists of a single casting of copper of the requisite shade, having a minimum resistance.

One of the first methods of transforming the alternating current into one of low voltage was that shown in Fig. 2. The current from the alternating generator passes through the coil B, wound around the iron ring A. The secondary coil C consists in this case of a few turns of very heavy copper wire. The large section of this wire itself and its short length produce an almost inappreciable electrical resistance, and this, therefore, governs the voltage of the induced current, which is carried off by it. From this secondary coil C, the current passes through the rods E D, the abutting ends of which are welded. Another form, which came out in 1886, is shown in Fig. 3. Here the current first passes through the coil B, which in this case is a ring placed within the iron coil A, the induced current being carried off by the single loop of copper of very large section C. Later forms of transformers are shown in Figs. 4 to 10, inclusive. These give a good idea of the transformers as constructed and arranged at the present time. In each case the dynamo current is passed through the primary coil, about which is placed a solid piece of copper of large section and which serves as a secondary. It is this construction that made necessary the making of copper castits of unusual size, since it was necessary to make the secondary coil in one piece in order to obtain low resistance, which would not be possible if it were built up.

The type of transformer now used, and which has been found to give the best results, is that in which the primary and secondary coils are concentrically placed in an iron core, so as to oblige all lines of force generated by the former to cut through the latter. If the two windings are placed side by side in an iron core, or upon opposite legs, as shown in Fig. 4, there is a tendency to form constant poles at the point where the two windings meet, due to the leakage of lines of force. The leakage will depend upon the distance between the two legs and upon the length of the magnetic circuit. It has been increased and turned to advantage by Prof. Thomson for obtaining constant current in the secondary, while the primary is supplied with constant electromotive force, this construction being shown in Fig. 5. Various forms of secondary may be employed to work in accordance with this principle, some of these being shown in Figs. 6 to 10, inclusive. For mechanical reasons and convenience the forms shown in Figs. 6 and 7 are mostly used, experience having shown that there is practically no leakage. This construction also permits the removing the primary without disturbing the secondary in the least.

The transformer in the rail chair welding machine, a cut of which is presented, consists of a massive copper casting of rectangular shape and formed with a central rectangular opening. In the opening is placed the iron core consisting of insulated sheets. In each side face of the copper casting is formed a square groove to receive the copper coils conveying the dynamo current—in this case the copper coils being formed of strips. It will be seen that the same principle is here present—an iron core surrounded by a primary coil of small strips, and a secondary coil of one turn of large cross section.

In all small sections, and in certain metals which fall down quickly when they approach the melting point, such as aluminum, lead, tin, etc., it is absolutely essential that the machine should be automatic. In general all electric welding consists first in bringing the two ends to be united in metallic contact, if possible, then to pass the current through them, and as the abutted ends become heated to the welding temperature, press the two parts forcibly together. In welding large sections this can be controlled by hand, since the heating is comparatively slow, and the increase in temperature can be readily observed, but in small sections, and with certain metals, where there is no external evidence of heat being present, the machine is depended upon for doing the work. In welding aluminum, for instance, the two pieces are clamped between copper jaws, one of which is movable and from the other. The two ends being brought together, the current is turned on, and at the instant the points have been heated to a melting temperature the movable clamp is pushed forward, the softened metal is thrown out on each side in the shape of an exaggerated burr, Fig. 43, and the electric current turned off at the same instant.

The uniformity of the result depends more closely upon the pressure applied to the movable clamp than upon any other condition. This pressure, which is governed by the size and material of the wire to be welded, should be in accordance with what we might term the plasticity of the metal when it has been brought to the proper temperature. If the current is too strong, the time necessary for welding alone would be affected, and in this case would be shortened. The pressure necessary is controlled directly by the metal itself, and therefore varies, and it is only to be ascertained by actual experiment. The pressure required for steel is approximately 1,800 pounds to the squre inch of section, and this, we may observe in parenthesis, explains why in the large welding machine, shown in Fig. 1, hydraulic plungers are introduced in order to provide this pressure. In iron a pressure of some 1,200 pounds to the inch is required, while for copper only 600 pounds is necessary.

It is of the utmost importance to disconnect the current at the instant a weld is made. Its continuance would only result in further melting the metal and in destroying the work already done. The movement in the case of a ⅛″ aluminum wire is about ¼″, the surplus matter being thrown out. Figs. 11 to 13, inclusively, show very clearly, first, the shape of the abutting ends of a steel rod of any section from ⅛″ up to 2″ in diameter, and also the effect produced at different stages of the process. When the two ends have been brought forcibly in contact and the current is in the change in color at the points of contact, which becomes a dull red and then brighter, and many, white hot. As the conical points heat the metal is softened, so that with the pressure it gives way and the area in contact is thus gradually increased. Owing to the fact that the resistance at all points of the circular section is not the same the heating take place unequally, and it is therefore advisable in large work, at intervals of a few seconds, to throw off the current in order that the heat already imparted to the metal may diffuse itself uniformly. When this has taken place, as can be perceived readily by the operator, the current is again turned on until an enlarged section has been heated. In this way the process continues until the entire section of the metal has been heated to a white heat, until the two parts have been forcibly pushed together, and then the operation having been completed, the current is turned off.

The appearance of the electric weld in a ½″ steel bar after it has been planed down longitudinally is shown in Fig. 14.

The planed surface was first highly polished and then subjected to dilute acid, bringing out the grain, as shown in the drawing, which has been slightly enlarged to more clearly show the grain. It will be observed that at the point of contact the grain has been deflected radially toward the surface, but has in no case been broken up. Its integrity is very apparent, the only change being in the direction. In the case of two metals, the line of demarcation separating the two ends is very clearly defined, and has the appearance of two pieces of soft material which have been pressed together Prof. A. E. Dolbear, of Tufts College, has made many hundred tests of the tensile strength of electrically welded bars of iron, steel and other metals. The results were of such a character that he stated that it was possible to weld both wrought iron and steel so that the weld is as strong as the same cross section in any other part of the bar. He had a number of bars welded by an expert blacksmith, the result being that the electrically welded bars were very much stronger than those welded by hand.

Fig. 93 represents a bar of brass and iron united by combined electric welding and a mechanical joint or dovetail, which is described further on. At and on each side of the weld, the metals were turned off slightly and then the bar was subjected to strain until ruptured, as shown in the draw-

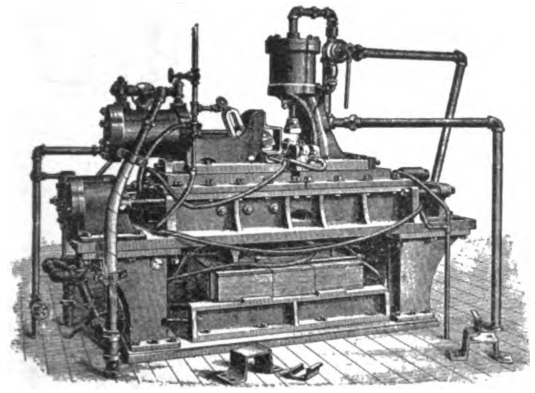
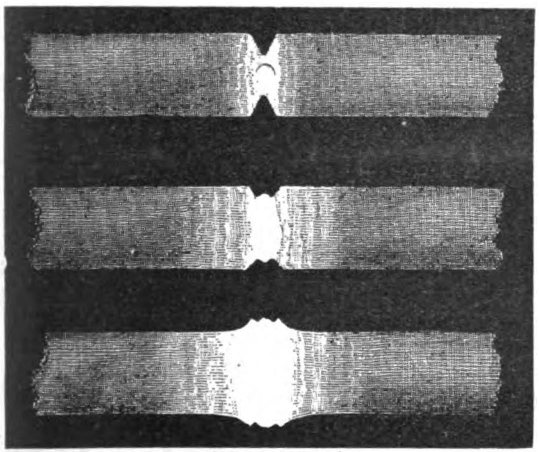


FIG. 1.



FIGS. 11, 12 and 13.

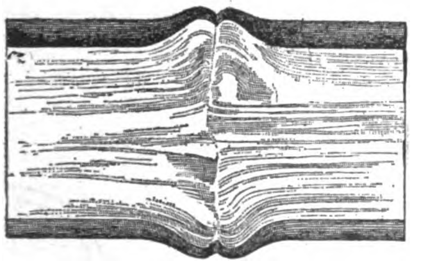


FIG. 14.

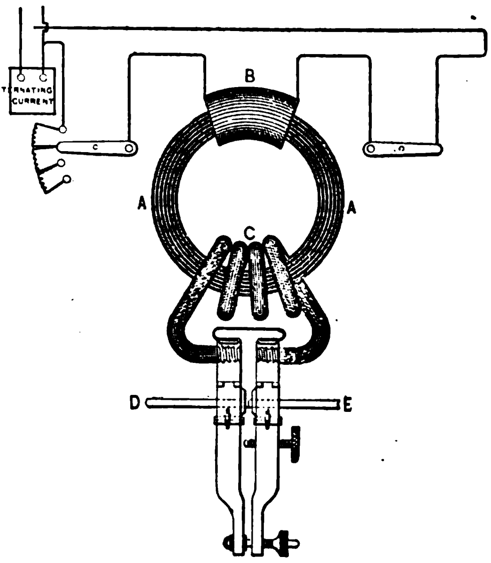


Fig. 2.—Early Type of Transformer

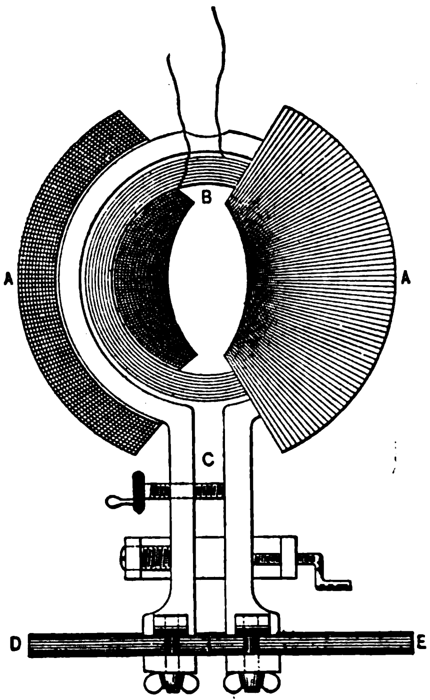


Fig. 3.—Later Type of Transformer.

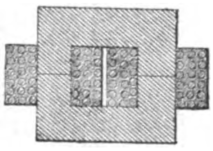


Fig. 4.

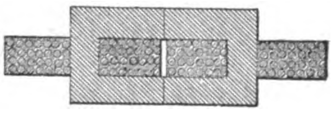


Fig. 5.

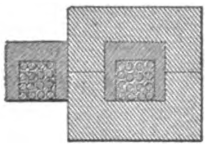


Fig. 6.

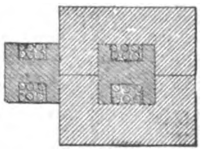


Fig. 7.

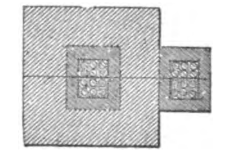


Fig. 8.

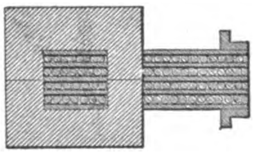


Fig. 9.

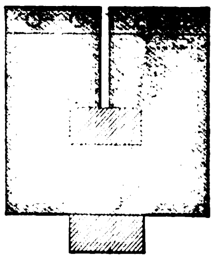


Fig. 10.

Present Types of Transformers.

ELECTRIC METAL WORKING.

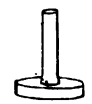


Fig. 15.—Bar Welded to Disk

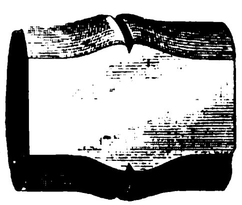


Fig. 16.—Weld in Steel Planed Down.

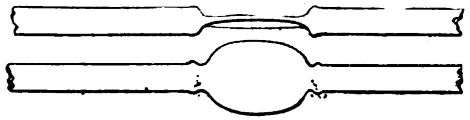


Fig. 17.—Weld Hammered Out.

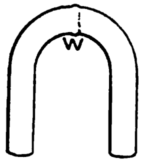


Fig. 18.—Bar Welded and Bent at Weld.

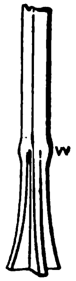


Fig. 19.—Rock Drill.

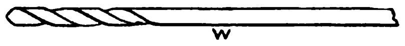


Fig. 20.—Twist Drill, Shank Welded On.

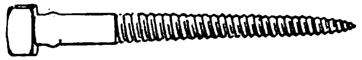


Fig. 21.—Head Welded on Screw.

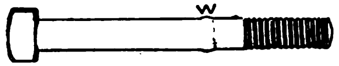


Fig. 22.—Screw Bolt Made by Welding.

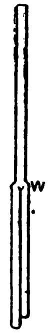


Fig. 23.—Two Bars Welded to One.

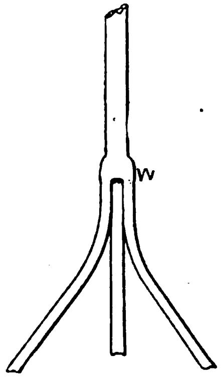


Fig. 24.—Three Bars Welded to One.

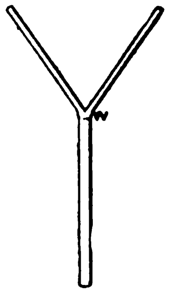


Fig. 25.—Similar to Fig. 23.

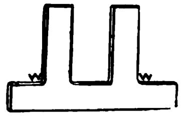


Fig. 26.—Two Flat Bars Welded to One.

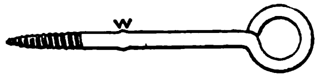


Fig. 27.—Screw Eye Made by Welding.

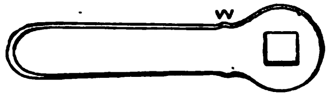


Fig. 28.—Wrench.

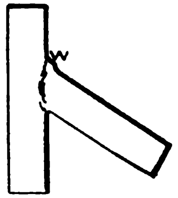


Fig. 29.—Bar Welded at an Angle.

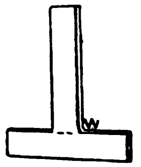


Fig. 30.—T-Square.

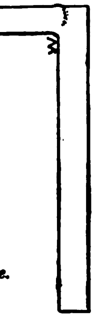


Fig. 31.—Carpenter's Square.

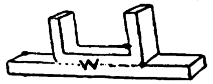


Fig. 32.—U-Shape Welded to Bar.

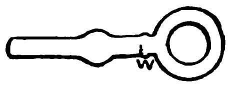


Fig. 33.—Welded and Upset

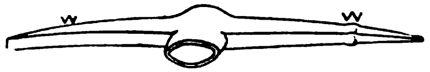


Fig. 34.—Pick.

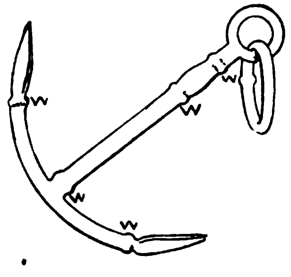


Fig. 35.—Anchor Made by Electric Welding.

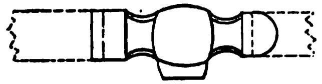


Fig. 36.—Heads Welded to Body.

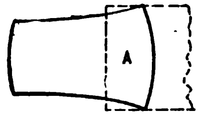


Fig. 38.—Blade Welded to Body.

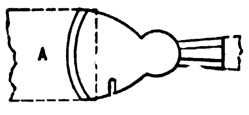


Fig. 39.—Blade and Head Welded to Body.

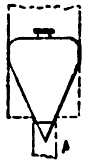
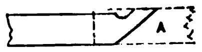
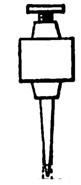
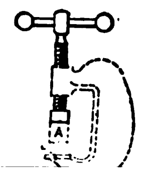


Fig. 41.—Point Welded On.







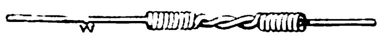


Fig. 61.—Old and New Telegraph Wire Splice.

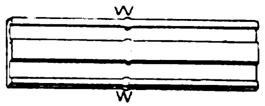


Fig. 62.—Welded Shape.

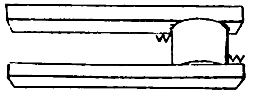


Fig. 63.—Two Bars Welded to Block

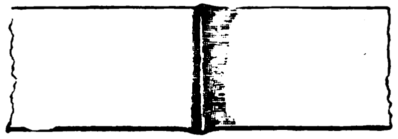


Fig. 64.—Thin Strip Welded.

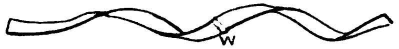


Fig. 65.—Thin Strip Welded.

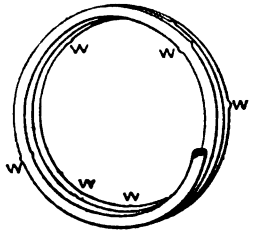


Fig. 66.—Coil of Pipe with Welded Joints.

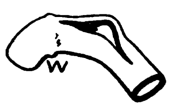


Fig. 67.—Pipe Tested to Rupture.

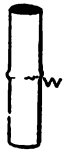


Fig. 68.—Pipe.

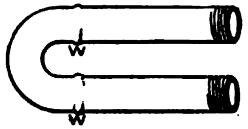


Fig. 69.—Cast-Iron Return Bend Welded to Wrought-Iron Pipe.

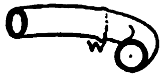


Fig. 70.

Fig. 71.—Wire Cable.

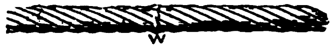


Fig. 72.—Wire Cable.

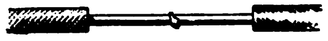


Fig. 73.—Insulated Wire Welded.

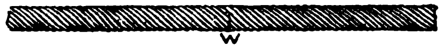


Fig. 74.—Cable.

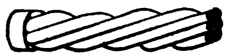


Fig. 75.—Cable with End Welded to it.

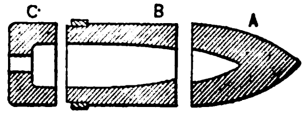


Fig. 76.—Projectile Ready for Welding.

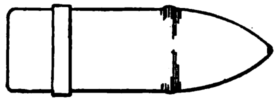


Fig. 77.—Projectile after Welding

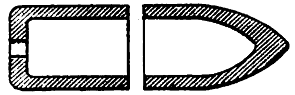


Fig. 78.—Projectile Formed of Two Parts.

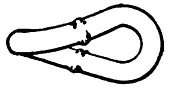


Fig. 79.—Chain Link.

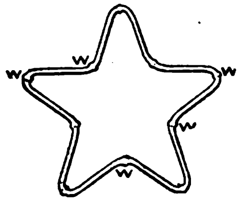


Fig. 80.—Star Welded at Each Bend.

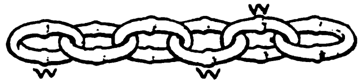


Fig. 81.—Chain.

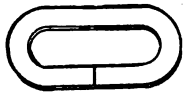


Fig. 82.—Flat Link.

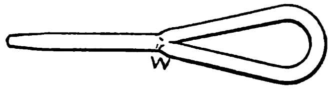


Fig. 83.—Eye Bar.

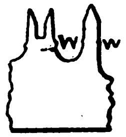


Fig. 88.—Tooth Welded in Circular Saw.

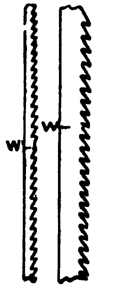
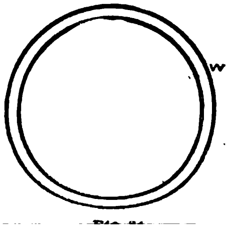
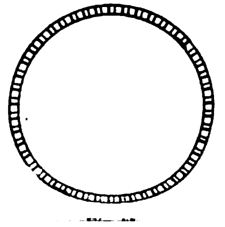
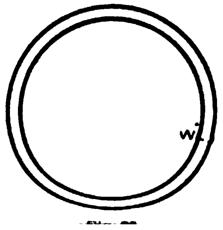


Fig. 89.—Band Saws Welded.







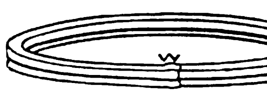


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Fig. 43.—Aluminum.

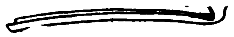


Fig. 44.—Bicycle Tire Bent at Weld.

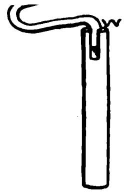


Fig. 46.—Bicycle Saddle Post.

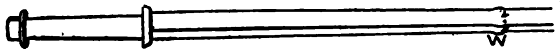


Fig. 47.—Axl

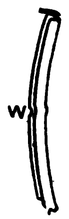


Fig. 45.—Bicycle Tire.

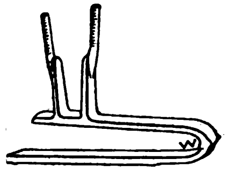


Fig. 52.—Clip

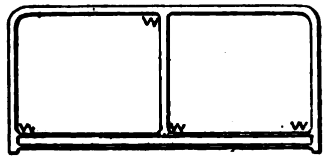


Fig. 48.—Dashboard Frame.

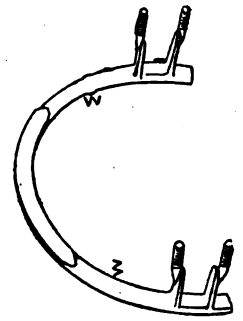


Fig. 50.—Fifth Wheel.

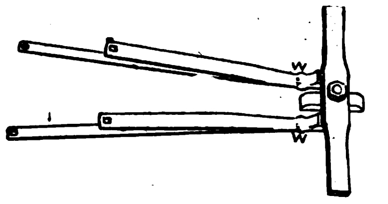


Fig. 53.—Double Perch Frame.

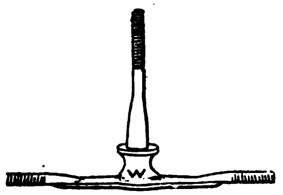


Fig. 49.—Clip King Bolt.

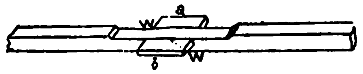


Fig. 51.—Axle Spring Bea.

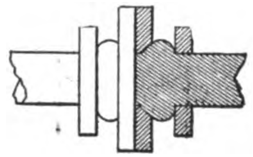


Fig. 58.—Section, Showing Upset Collar Finished.

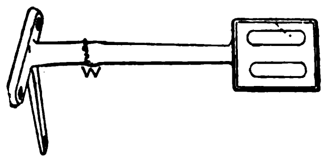


Fig. 54.—Carriage Step.

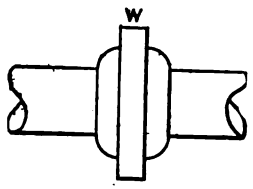


Fig. 59.—Upset Collar.

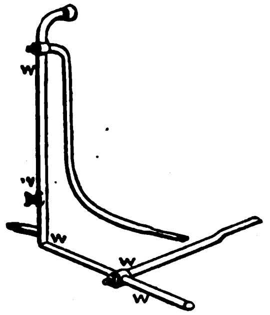


Fig. 55.—Seat Frame

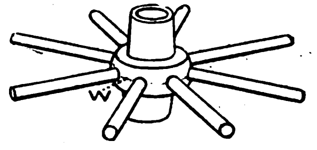


Fig. 56.—Wheel Formed by Electric Welding.

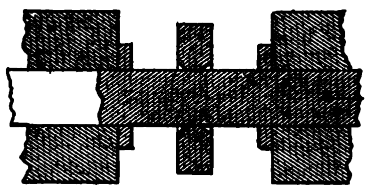


Fig. 60.—Parts Arranged for Welding.

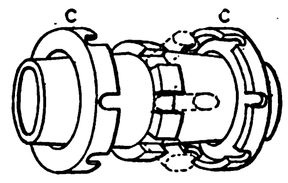


Fig. 57.—Parts of Wheels Assembled for Welding.

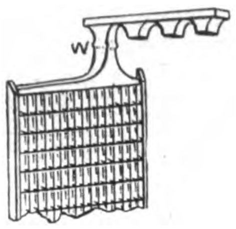


Fig. 90.—Typograph Lever.

Fig. 91.—Welding Different Metals.

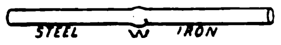


Fig. 92.

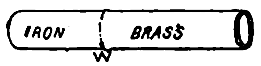


Fig. 94.

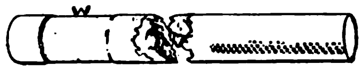


Fig. 93.—Bar Broken, but not at Weld.

Fig. 95.—Lead Plate for Storage Battery.

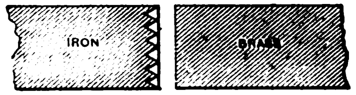


Fig. 96.—Mechanical Joint and Electric Weld.

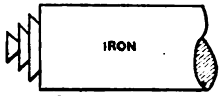


Fig. 97—Form of Iron End.

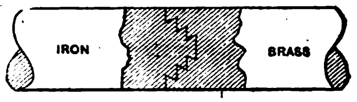


Fig. 98.—Section Showing Weld and Joint.

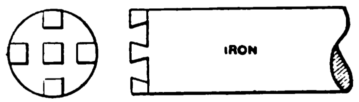


Fig. 99.—Another Form of Joint—Dovetail.

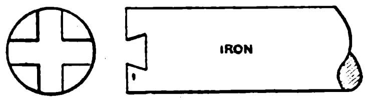


Fig. 100.—Dovetail Joint.

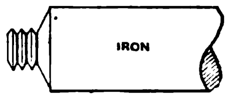
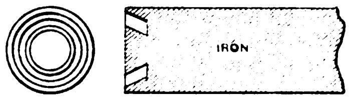


Fig. 101.—Threaded Joint.

Fig. 105.—Spiral from Machine, Fig. 104.



Fi . 102.—Ring Joint.

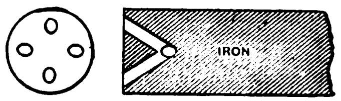


Fig. 103.—Another Form of Joint.

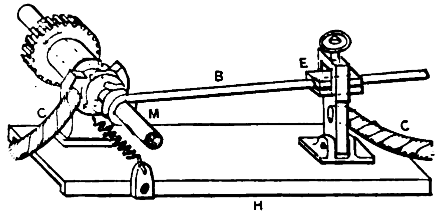


Fig. 104.—Electrically Heating and Coiling.

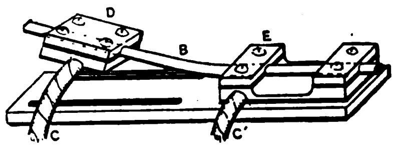


Fig. 108.—Electrically Heating and Bending.

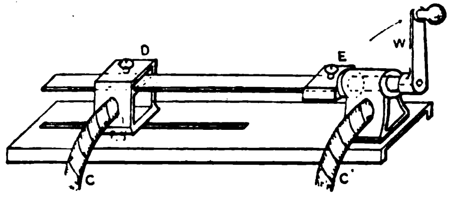


Fig. 106.—Electrically Heating and Twisting.

Fig. 110.—Shape made on Fig. 108.

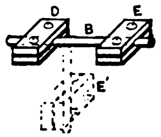


Fig. 109.—Second Step in Machine, Fig. 108.

Fig. 107.—Specimen of Twisted Metal.

Fig. 111.—Electrically Heated and Upset.

ing. The break was in that part of the bar which has not been reduced in diameter, proving that the joint was stronger than any other part.

Hard tool steel can be welded without destroying its good qualities. We have before stated that the heating took place at the point of contact of the two bars, and that heating can be effected locally or at any desired point in a continuous bar. This has one special advantage in that the expenditure of energy is confined directly to the point desired, and that there is no superfluous heating. In other words, a bar having been welded can be picked up within three or four inches of the weld, the temperature at that point then being so low as to be hardly perceptible. That this is true is shown by the welding of insulated copper wires. The coverings is removed, Fig. 73, for a distance just sufficient to admit the clamps. The remaining covering is not injured in the least. In welding wire cables, Figs. 71, 72 and 74, the wires are fused into a solid bar for about one inch and the hemp core charred for a like length.

The point has been frequently brought up by those not conversant with the process that there is a certain amount of danger attending the handling of these machines. This is due mainly to the fact that it is supposed that a current of sufficient strength to bring a large section of steel to a white heat would naturally have sufficient power to create disagreeable results in the man who might be so placed as to permit any part of it to pass through him. The writer may state he has placed his moistened fingers on the two copper clamps of an electric welding machine through which the current was passing in the act of welding 2″ steel bars. It was impossible to note any effect whatever, as there was absolutely no sensation.

One of the most recent successful applications of the electric welding process is carried on at the works of the Johnson Co., Johnstown, Pa., in the making of rail chairs. A prospective view of this machine and also views of the two parts composing the chair, as well as the completed chair, are shown in Fig. 1. This machine is used in welding what may be termed the rail clamp to the top of the rail chair proper, the shapes of both of these being clearly outlined in the drawing. In the upper left-hand corner of the machine is a hydraulic cylinder, the piston rod of which is arranged so as to operate an elbow lever, the right hand arm of which, when the plunger moves forward, presses upon and firmly holds the body of the rail chair. The cylinder and the lever it operates are mounted upon a sliding base similar in many respects to the platen of a planer, which is arranged to be moved forward by means of the two hydraulic cylinders shown at the left. These cylinders are 8″ in diameter and have a stroke of about 2″, and are adapted to give a pressure of about an average of 1,800 pounds to the square inch of welding section, which in this case is about four square inches. The cylinder shown at the top and to the right is adapted to hold the rail clamp in position during the operation of welding, and also to resist the pressure brought to bear by the operating cylinders. It has been found that with the aid of this machine rail chairs can be economically produced, and that the integrity of the weld can be relied upon implicitly.

The arrangements of the small drawings representing what has been done in electric welding in a practical way up to date has been with a view of grouping them according to the shape and material operated upon, without any reference to the application of the process to any particular industry. Fig. 15 shows a bar or standard welded to the center of a disk. Fig. 16 is similar to Fig. 14, and is intended to show that the line of demarcation separating the two pieces welded is absolutely imperceivable unless, as stated before, the plain surface is first polished and then treated with acid. Fig. 17 shows an electric weld which has been hammered down, the edge and flat view of the welded portion being represented. This is intended to illustrate the perfect continuity at the point of welding. Fig. 18 represents a bar which has been welded straight and then curved at the weld. Figs. 19, 20, 21, 22, 27, 28, 33 and 34 represents various applications of electric welding in straight and bar work, and where, as in the case of the drill, Fig. 20, the rock drill, Fig. 19, and the pig, Fig. 34, it is essential to make the cutting point of tool steel and the shank of softer metal. Figs. 26, 29, 30, 31 and 32 shows the welding of different shapes. Fig. 23 shows two bars which have been welded to the end of one bar, Fig. 25 representing the same shape, but with the legs spread. Fig. 24 is the same construction except that three bars have been welded to the end of one. Fig. 35 is an anchor made by the welding process, there being, as indicated by the letter W, five welds.

In the drawings Figs. 36 to 42, inclusive, another branch of electric welding is shown which consists in adding to a body of soft material a short length of hard steel, the additional portion being represented in each case by the letter A. In the case of the hammer, for instance, Fig. 36, the body is first formed and then material for the two heads is added from a bar of steel by an electric weld, the proper lengths being afterward cut off. In the same way the axe blade, Fig. 38, the trammel point, Fig. 40, the plum bob point, Fig. 41, the lathe tool, Fig. 37, the hatchet blade and head, Fig. 39, and the dog clamp, Fig. 42, being provided in a similiar fashion.

Figs. 44 to 46 represent where the electric welding process has come into the manufacture of bicycles. Fig. 45 is a drawing of the U-shaped bicycle tire, showing the weld. In this work it has been found that the operation of welding can be performed more expeditiously, more economically and with far greater success than with any other known method. In this it is particularly true that during the operation of welding, the operator not only knows whether he will make a successful joint or not, but he is also informed, as we might say, of the nature of the material during the work, and is therefore in a position to act in a certain sense as an inspector. Fig. 44 shows where the tire has been bent at the weld, and is intended merely as an illustration of the perfect condition of the pieces at the point. The standard carrying the seat in some bicycles consists of a tube in the upper part of which is held a spring frame carrying the seat. This is shown in Fig. 46, where the parts are ready for brazing.

We may here state that brazing operations are carried on by aid of the electric current in a far more advantageous way than with the ordinary furnace. The work being prepared, as shown in the drawing, a few turns of thin wire are wrapped around the entering bar, then the whole thing is placed in the welding machine, the result being that the wire melts, flows down and effectually seals the joint. In the ordinary way where a flux is used the work for a considerable distance each side of the joint is tarnished and more or less time is therefore necessary in order to clean it. With the electric process the joint is kept clean and there is little work to be done after the brazing has been perfected.

Figs. 47 to 55 represent the position now occupied by electric welding in carriage work. It is in this industry that the method has been found to be peculiarly valuable, since the material, form and dimensions of the iron work entering a wagon lead themselves readily to the process. Beginning at Fig. 48, these drawings show the weld in first, the dash board frame, clip king bolt, fifth wheel, axle, spring bed, clip, double perch frame, carriage step and seat frame. In making the axle spring bed, Fig. 51, the two pieces *a b* are welded to the side of the axle.

The method of making a metal wheel by the welding process is shown in Figs. 56 and 57. The hub and the two rings *c c* are shaped as indicated in Fig. 57, the spokes being entered in the recesses provided for them, as indicated by dotted lines. The hub is then clamped in the welder, the resulting wheel being shown in Fig. 56. This method increases the strength and durability of the wheel, and at the same time makes possible the employment of lighter material.

Unsettling a collar or an axle or similar bar is shown in Figs. 58 to 60. The separate parts are first arranged as shown in Fig. 60. The current is then passed through the bars, which are forced together, the result being as represented in the section Fig. 58, and the side view, Fig. 59. The old and new telegraph wire splice is represented in Fig. 61. The welding of a shape of peculiar section is represented in Fig. 62. The ends of two bars of rectangular section welded to the cylindrical piece is shown in Fig. 63. One of the most difficult operations to perform successfully by any method of welding is that of uniting wide flat strips of thin metal. This is shown in Fig. 64, the drawing of which was made from a piece 3-64″ thick and 1½″ wide.

Pipe welding is shown in Figs. 66 to 70, Fig. 67 representing a pipe which has been tested to rupture and shows that the break was stopped at the weld. Fig. 69 shows a return bend of cast iron, welded to lengths of wrought iron pipe for refrigerator work. A peculiarity of the welding of pipes is the fact that the burr is only on the outside of the pipe, the tendency, when the metal has been heated and then pressed together, being to force the surplus metal outward. Provision has been made for removing the outside burr by means of a pneumatic hammer. A practical application of pipe welding by electricity has been made in the making of coils of very long lengths of pipe. In this method the welder is carried upon a car, during the movement of which forward a new length of pipe is welded to the preceding length. From the welder the pipe passes through a heating furnace and is heated to the proper temperature in order to be wound in a coil around the mandrel. Following the welder is a testing apparatus which tests the pipe after each joint has been made. In this way pipes of any length can be made and the joint readily bent. Figs. 76 to 78 show the electric welding process applied to the manufacture of projectiles. In the first view the point A and the base C are welded to the cylindrical body B, the perfected shell being shown in Fig. 77. Another method of making the shell is shown in Fig. 88, the shell here consisting of but two parts.

Figs. 71 to 74 shows the welding of wire cables, Fig. 75 showing where a piece has been welded to the end of a cable in order to prevent fraying. As was stated previously, the welding process converts about one inch of the cable into solid metal, and if a hemp core be present, it chars it for a like distance. Figs. 79 to 82 represent chain and circular work, the points of welding being indicated. Fig. 83 shows one of the eyes of an eye bar. Fig. 88 represents a portion of a circular saw of large size, in which a new tooth has been placed by the electric process. Fig. 89 shows the welding of a couple of band saws, large and small sizes. The fifth wheel shown in Figs. 84 to 87 is formed of three parts, shown in the first three figures. The shell consists of two channel sections, Fig. 84 and 86, in which are held rollers, the completed wheel being as presented in Fig. 87.

The welding of different materials together as shown in Figs. 90 to 94. A difficult task, and one not possible with any other process, is the welding of storage battery plates of lead, as shown in Fig. 95.

A combination weld and mechanical joint is shown in Figs. 96 to 103. It will be noticed that the end of the iron bar is so formed that the brass bar to which it is intended to unite it will constitute a mechanical joint or dovetail after the ends have been brought together, and subjected to the welding process. Several forms of making the dovetail are shown, Fig. 98 being a sectional view at the weld and being intended to show that the brass flows in so freely as to completely fill the grooves cut in the iron. In arranging these pieces for welding, the clamps in the machine are so adjusted that the iron is first heated a short distance from its points of contact with the brass. The heat then follows by conduction along the iron and gradually increases the temperature of the abutting bar. After the brass bar has become heated thoroughly it begins to flow, and as the two parts are pressed together the metal flows down, fills the grooves cut on the iron end completely and make a perfect mechanical joint, which is independent of the uniting of the two ends together by fusion. This joint, as explained and as shown in Fig. 93, possesses greater strength than the weaker metal of which it is composed. This method has been found of great convenience in the manufacture especially of reciprocating electric engines, where it is desirable to have a soft iron core of a specified length, to each end of which is welded a brass extension, which serves as a guide.

The heating and bending of metals and their upsetting are represented in the remaining figures, Figs. 105 to 111. In the machine shown in Fig. 104 the metal to be coiled is placed in the clamp E and attached to the mandrel M, the current passing through the conductors C C. After having been heated to the proper degree, the mandrel is turned, the result being a coil, as shown in Fig. 105. Fig. 106 is practically the same arrangement, except that the clamp E is provided with a handle by which it may be turned in order, after the strip has been heated, to form the twisted shape shown in Fig. 107. Bending of the bar B after it has been heated is shown in Fig. 108, where the clamp D is movable, the second operation after the bar B has been bent to a right angle being shown in Fig. 109, the result being shown in Fig. 110. Fig. 111 represents a bar which has been heated and then upset.

Electrical

Electro-Plating—Gold Plating.

Electro-gilding and electro-plating differ only in the time required in the operations. An article may be strongly coated with gold in about three minutes and is fairly durable, or it may be only colored with gold in from three to ten seconds, but to put a good coating on a watch case, etc., it would require one to two hours where a dynamo was used.

Gold plating is not so troublesome to handle as silver. It is as easily deposited as nickel, if the operator desires to simply color the article or gild them. It can be very quickly and neatly done by the following formula, for a gilding and coloring solution: One pennyweight of gold placed in a coffee cup, to which is added one ounce of muriatic acid c. p. and ⅛ of an ounce of nitric acid c. p. Place the cup in a pan of hot water to hasten the action of the acid in dissolving the gold. When the gold is entirely dissolved pour the solution into a ½-gallon glazed crock containing one quart of hot water and add cyanide of potash—a little at a time—until effervescence ceases. The solution is now ready.

The articles are prepared for gilding the same as for silvering, excepting that they are not immersed in the mercury dip, and instead of scouring with pumice, they are scoured lightly with a sponge moistened with cyanide water and fine whiting. If the articles are very small they may be bunched—or a number may be strung on one wire. When placed in the bath they should be constantly moved about in the liquid—being careful not to allow the work to touch the anode, as in that case wherever the anode and the work come in contact, a black mark will be left, or burnt. When the articles are sufficiently gilt, rinse in cold water, then in hot water, then dry rapidly in box-wood sawdust. If dried properly the articles will be a beautiful bright gold color and will not need polishing.

This is a process used in gilding metal, dress trimming, cheap jewelry, collar buttons, etc. This solution must be worked hot and a small piece of sheet gold used for an anode. By continuing the immersion of the articles a very durable and heavy coating of gold may be had, but as the gold thickens it will gradually lose the bright color, which must be imparted by means of briskly polishing with a chamois skin charged with jewelers' rouge, or with a soft cotton flannel buff.

Fresh water must be added to the gilding bath from time to time to replace the loss of evaporation. If this is not attended to, the color of the deposited gold will vary. If this solution is used cold, the deposit will be a yellow color, and according to the temperature of heat will vary from a beautiful orange to a deep red color, so that with a little practice the operator can produce the various gold colors at will.

In all the operations of nickeling, silvering or gilding, the work must be carried on without interuption until finished. Many practical platers make up gold solutions by what is known to the trade as the battery process, and for all practical purposes does the work as well as solutions chemically prepared, and is done as follows:

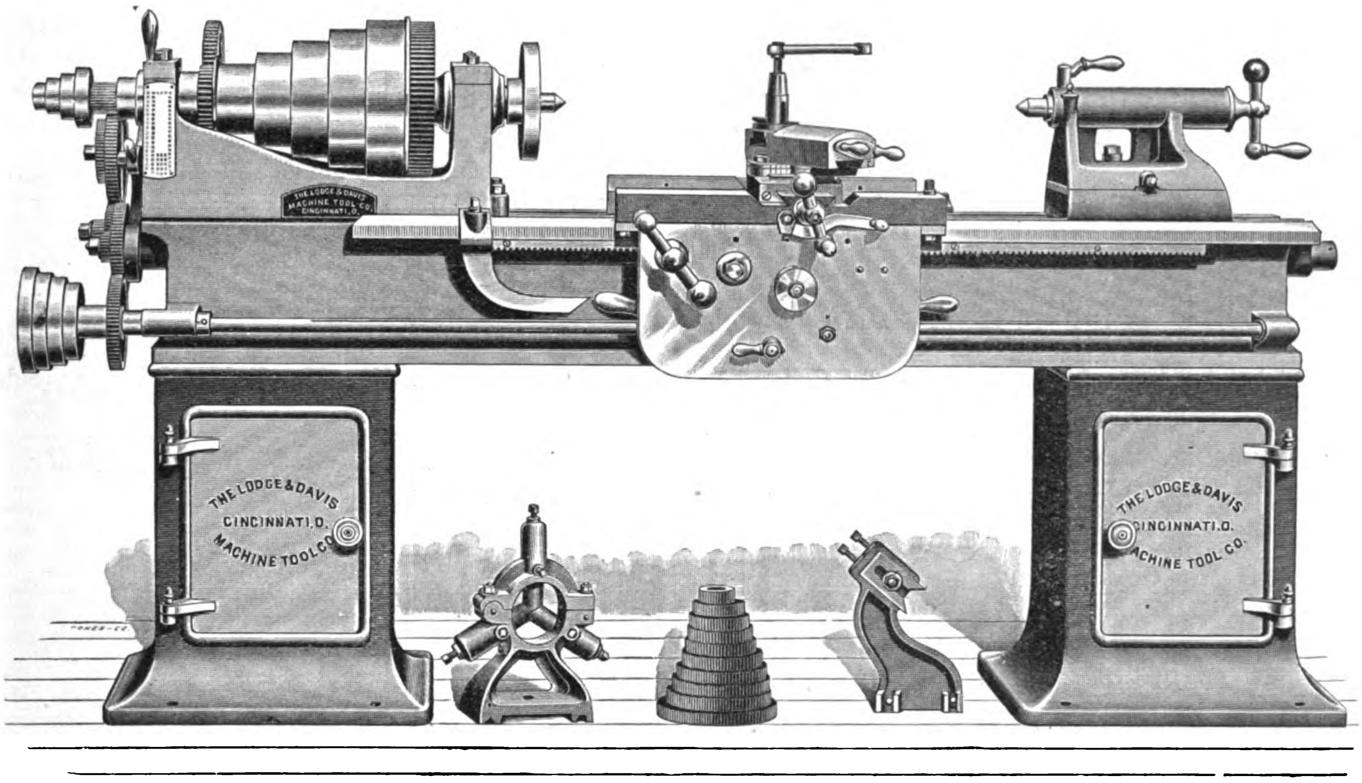
Dissolve ½ a pound of c. p. cyanide of potash in one gallon of hot water. Fill a small porous cup full of the prepared liquid and place the cup in the jar or crock containing the solution. Now take a piece of copper and attach it to a wire fastened to the plating bar and immerse it in the liquid in the porous cup. Then attach a piece of sheet gold to the anode bar (by a copper wire) and immerse it in the outer liquid, turn on the current and the gold will dissolve into the solution. The time required to impart sufficient metal to the solution will be about four hours, if the solution is warm. If cold, it will take a much longer time—all gold solutions work better and quicker if worked hot, besides it is easier to regulate the color. With a solution very strong in gold a variety of fine gold colors can be produced by exposing or suspending a large or small surface of the gold anode in the solution during the plating process. Where the operator has not the advantage of a dynamo, a chemical battery may be used.

For nickel plating we would recommend the Bunsen type of battery. Although the same battery can be used to good advantage in gold and silver plating, it would be more satisfactory to use a small battery for the two last named metals. Either of these batteries can readily be procured of dealers in electrical supplies at a cost varying from $2.50 to $3, and are better and cheaper than could be made at home. For experimental purposes the proportions for the plating solutions can be reduced to any quantity desired.

Clough.

IMPROVED 16-INCH SWING TOOL LATHE.

The lathe represented by the accompanying cut is furnished with five-step cone of large diameter for a 2½-inch belt, and is powerfully geared. The spindle is made of high grade special steel, with a $1\frac{1}{16}$ hole, and is ground perfectly true on Universal grinding machine of the highest standard. The spindle bearings are of extra length and are made of bronze, containing 85 per cent. of copper and 15 per cent. of tin. The bearings are provided for taking up the wear, and for constant and easy lubrication. They are fitted to present a full circle their entire length, care being taken that the solidity of the lathe does not depend on the tight fitting or the adjusting of screws. The feed is transmitted by belt running on a four-step cone, and also by direct positive gearing giving a range from 8 to 175 cuts per inch. All feeds are reversed in the apron. An index is provided for graduating the cross feed. An automatic stop for the carriage is furnished, which may be set at any place on the ways. This is a desirable feature where large quantities of duplicate work is being done, besides making it convenient to drop rack pinion out if desired, when cutting screws.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IMPROVED 16-INCH SWING TOOL LATHE.

All feeds will reverse instantly without losing a fraction of a revolution. The carriage has a long bearing on the ways and compound rest has a bearing on the cross slide of 13". The compound rest is also provided with an index that it may be swiveled to any degree with the greatest accuracy.

The lead screw is placed inside of the bed, is covered to protect it from dirt and chips, and takes hold of carriage under the tool post and directly beneath the line of strain. This is an important point, as it obviates all tendency to twist the carriage when taking a heavy cut, as will invariably occur when the lead screw is at the front or rear of the lathe.

The half nuts which are operated by an entirely new device, are made from solid metal (not babbitted) and have planed bearings seven inches long.

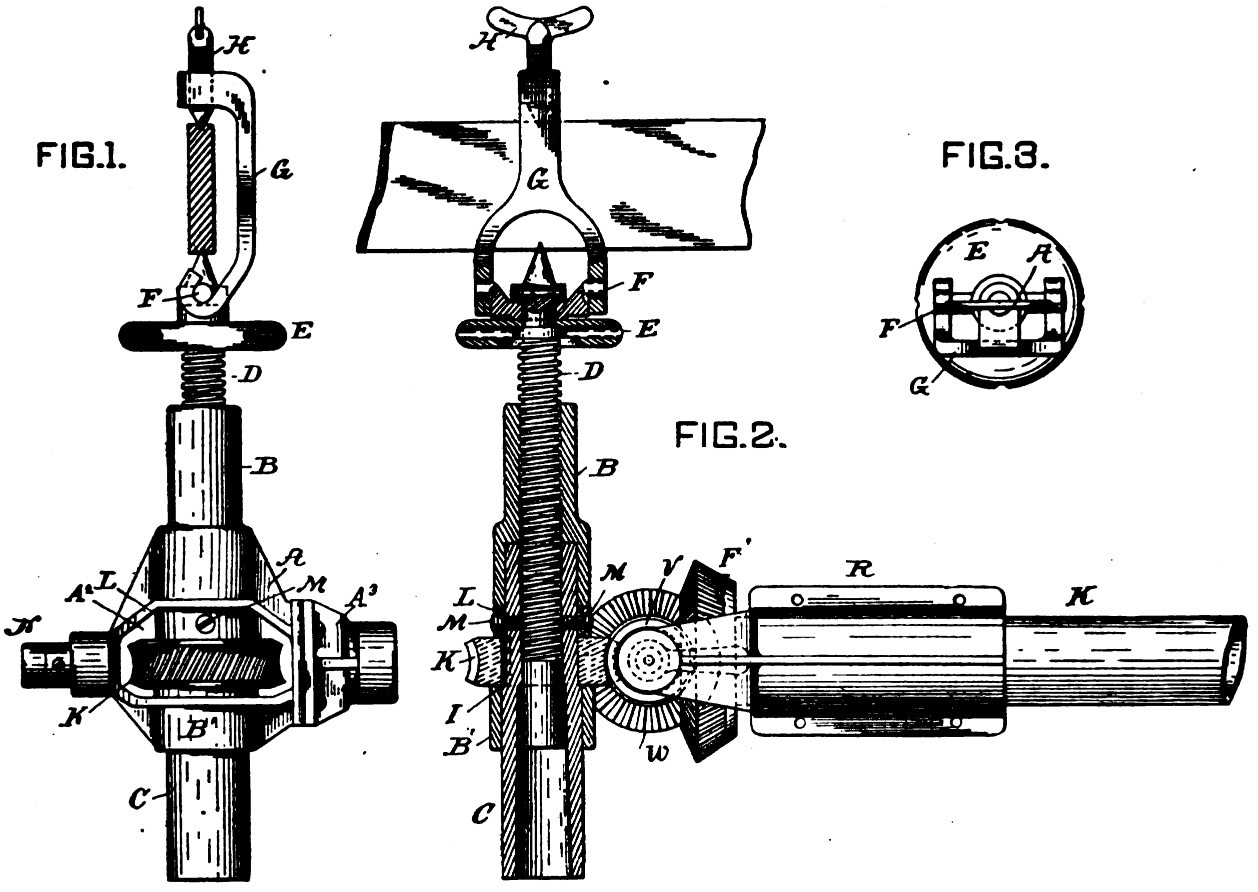
This lathe has many interesting features we can not speak of, but it will be of interest to readers to know that by sending a card to The Lodge & Davis Machine Tool Co., Cincinnati, O., a full description can be procured.

A NEW DRILLING MACHINE.

The machine herewith shown (letters patent for which were issued to Wm. W. Varney, 1001 Harlem avenue, Baltimore, Md., December 22, 1891) was designed for shipbuilding, boiler and bridge work and to be driven with electric motor mounted on trunnions or a swiveled stand. The object of this invention is to produce a drilling machine which will be light, compact, and simple in its construction, in which the drill stock will have in two directions movement, so that it may be operated in various positions, and the driving shaft so arranged that the drill stock may be operated at various distances from the source of power without moving said source of power, and by means of which the drill may be thrown into or out of motion readily without interrupting the driving mechanism, and the said stock allowed to slip or rotate independently of said driving mechanism, if the drill should become jammed or stopped, so as to prevent injury to the tool or the mechanism of the machine.

Fig. 1 represents a front elevation of the drill-stock frame detached from the main frame, showing also the drill stock, worm gear wheel and supporting dog holding the device to a supporting beam or timber. Fig. 2 represents a view, partly in vertical section, showing the drill stock frame at right angles to the position represented in Fig. 1, and the main frame and driving gear in connection therewith. Fig. 3 represents a top view of a portion of the machine, showing the dog whereby the machine is held in position.

The operation of this machine is as follows: The device being secured in position, as shown in Figs. 1 and 2, power applied to the shaft P′ is transmitted through the telescopic shafts and intermediate gearing to the tool-stock. When it is desired to stop the drill, the rod Y is turned to release the friction-clutch mechanism, consequently stopping the motion of the drill-stock without stopping the driving mechanism. The friction-clutch also slips in case the drill meets with an obstruction, thus preventing injury thereto or to the operating mechanism. When drilling downward in a vertical position or at an angle, the dog G is employed to prevent the drill and the machine from dropping when the work is finished. In drilling in other positions the dog may be removed, as it is not necessary.



A NEW DRILLING MACHINE.

It will be perceived that the frame A has a swinging motion on its trunnions or journals, so that the drill may be worked at any angle, and the main frame and driving mechanism may be moved around the driving-shaft, thus permitting the drill to have a universal movement with relation to said driving-shaft, which enables it to be operated in any desired position to said driving-shaft, and at an angle thereto without either moving said driving-shaft or the source of power. This cut is from *The Iron Trade Review.*

A SET OF FINE TOOLS.

BY WM. HARRISON.

[Let not the reader whose taste does not run to that which diverts as well as instructs the minds, and who shuns fiction as unprofitable stuff, think that he will violate his custom by perusing Mr. Harrison's paper. It is essentially true, and those who skip it will miss a narrative that substantiates the saying that "Truth is stranger than fiction."—Ed.]

For a few moments Charley Adams and his family felt as much distressed as they had before the stranger called. Not one of them supposed that it was anything but an error, and they considered that their duty was to leave the money intact until he should discover the mistake and return to correct it. But after turning the matter over in his brain a few moments, Charley recollected that Mr. Ellis had stated that money was of no consideration to securing secrecy and that it must be had at any price. This quieted his fear somewhat, and he sensibly decided to make a hole in one of those hundred dollar bills forthwith.

He returned from the grocery groaning under his load, and they had a supper that none of them could possibly forget to the last day of life.

But Mr. Ellis did not show up Sunday to take back the small fortune (to the Adams family) which he had left. Nor did he call on Monday. He, however, sent the drawings and instruction promised. There were about a dozen and a half of articles to be made—some very simple, others difficult. Charley was so nervous to get at the job that he did not look for ideas upon which to hang conjectures as to what kind of a machine the tools might be intended to be used in building. There were some long forceps, some ratchets of queer pattern and other instruments, evidently adapted for special work. He paid no attention to the matter of their use, but bent himself to the task of making them properly, in the shortest possible time. He remembered the injunction to say nothing, no matter what he might think, and so would not have permitted curiosity to influence his mental actions.

With the drawings came a set of name stamps, which were to be used on the steel, in places that would be the most obscure when the tools were finished, before it was tempered. The name was, H. G. Logan, New Orleans, La. Mr. Adams unrolled them, and laying them down on a little shelf near a similar set which spelled out his own name and city, he congratulated himself that there was nothing in this work that should give him any trouble. If it should, he would ask some of his friends for help, without disclosing the nature of the job.

But he got along with it very nicely. The blacksmith, a confidential friend of his, put on the letters and tempered the steel, making a very fine job, and brought the material up to him. He labored away day after day, and sometimes far into the night, as happy as a meadow lark, humming his favorite tunes and building air castles more lofty and magnificent than the mountains of vapor heaped up picturesquely, like a far-off, enchanted region, in the sunset sky, by an Autumn wind.

Mr. Ellis called several times and expressed his entire satisfaction with the progress of the work. When, in eight days, all were finished, he paid Mr. Adams five hundred dollars more, taking no receipt. He then left town, telling the young inventor that he might have further use for him.

Charley Adams now made up his mind not to let the money get away from him until he had placed himself in a position less precarious than had been his lot for some years. He had unlimited confidence in his machine. It was a new idea, in a new field. There were no patents that touched upon any detail of it, even remotely. He had the ground well covered by six different sets of claims and patents. One thing he was shrewd in, and that was in getting the idea and all the outgrowing ones so carefully embraced as to leave no shadow of excuse for some predatory, thieving manufacturers to construct a machine substantially the same, but resting on some flimsy claims simply for a pretext to continue manufacturing, while the real inventor was trying to get the courts to decide upon the merits of the case and give him his rights. He knew how the efficacy of tactics to fight off an infringement suit, or an injunction, had enabled wolves to carry off the benefits of inventions, and he fixed it so that no one would be likely to attempt it on him.

So Charley Adams went about it to develop his patent, and he soon began to make money. The poor, old father and mother, and the sweet-faced, patient sister could hardly believe their senses when Charley told them that the royalty on three machines in operation near their city, was bringing him in an income of $10 per day. It was a happy family, I can assure the reader.

They soon moved out of the rattle-trap of a house, in bad sanitary condition, in a miserable district, and occupied one, belonging to Charley, in a pretty street in the suburbs. There they had a horse and buggy, and for the first time in their lives, enjoyed the luxury of a drive every pleasant evening.

A good many people of consequence called on Mr. Adams, and his prosperity began to bring him into prominence. It would have given him immediately a very high place in the business world had the importance of the device been adequately known.

Charley's friends (I use the word in its true sense) looked out sharply for signs of bad judgment and foolhardiness in him. They knew how he had a passionate desire to establish a shop-school where all the boys who wished to could be taught the machinist trade absolutely free, and thus help to create skilled workmen, for all-around work. He was really a philanthropist, and his aim in life was to advance the interests of mechanics. His friends cautioned him not to put money into any such a project, at least till a large subscription could be raised and a start made under most favorable auspices. He promised to be careful, but said that he certainly would do something in that direction some day.

Like most young men, Charley had a girl. She was a very nice girl, too, the daughter of a manufacturer who had been a patron of the technical school at which Charley lectured. In his days of abject poverty he had not been able to pay her much attention, but since fortune had smiled on him, he renewed his visits to the Ludlow house. Mabel was discriminating enough to see that among the scores of young bloods from the *av'noo* who met her in society, not one was as bright and gentlemanly by nature as C. C. Adams. No girl of good taste could very well fail to like him, and their intimacy grew. Charley had thought that if he ever got his business on its feet he would ask no other boon. But now that he was acknowledged to be worth $75,000, with an income of $25 000 a year, he could not be perfectly happy until united to Mabel Ludlow. All the neighbors and the city folks in general thought it would be the best match made in a year, but old Si Ludlow was not so well pleased. He had no objections to Charley as a man, but he was a purse-proud scion of a purse-proud family, and he wanted to be doubly sure that the success of, a man who was to become his daughter's husband was entirely substantial with no block of chance for a corner stone. He had, therefore, been rather chilly to the arduous young lover. But Mr. Adams was impulsive, and could not brook the delay. He asked Mabel for herself and got her, every inch, in short order. He now asked the father, and was informed that the matter would be taken under advisement.

At length a day was set for Ludlow's answer. Charley knew that he had been gathering all the information possible concerning the status of his affairs, and had particularly gleaned the details of a few temporary failures of his machines, owing to bad construction. These, of course, were replaced, but the fact that trouble was experienced seemed to occupy a good deal of the attention of the agents of some one—without doubt, Si Ludlow.

Charley felt a little nervous when Ludlow, a short, swarthy man, walked in, nodded, grunted, extended his forefinger and sat down on a large leather divan. Still, he could not see how his finances could be a bar to him, for he was really worth nearly as much as Ludlow, if the truth was known.

"Mr. Adams," said the old man, looking rather severely at him through his gold-rimmed spectacles, "a peculiar thing has come to light concerning you which I can scarcely see through. I can not understand, either, how it can be reconciled with your supposed business and good character."

"Please explain yourself more fully, Mr. Ludlow, and perhaps I can easily disperse your misgivings," said Charley, not a little agitated.

"A friend of mine had his house robbed two days ago, and he brought me this, which was left behind by the thief. Please look at the letters and tell me then what this means and who and what you really are."

Ludlow spoke with an air of indignation, as he handed Charley a pair of long forceps. In a place somewhat obscure was the name, stamped in the steel, "C. C. Adams, Detroit. Mich."

A cold sweat stood on the brow of the young inventor. This was a pair of the forceps he had made for Mr. Ellis, but instead of putting on the stamps furnished him, he had exchanged them for his own, and his name and address was now stamped on sixteen instruments, forming a set of the finest burglar's tools ever made.

He felt that it would be a relief to be swallowed up by the earth.

[To be continued.]

A national association has been organized in New York to extend the industrial scheme of profit-sharing. United States Labor Commissioner, Carroll D. Wright, is President; N. O. Nelson, of St. Louis, and F. A. Walker, President of the Massachusetts Institute of Technology, Vice-presidents, and Nicholas P. Gilman, of West Newton, Secretary and Treasurer.

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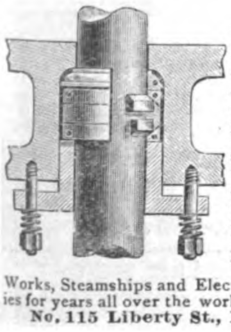

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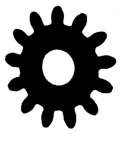

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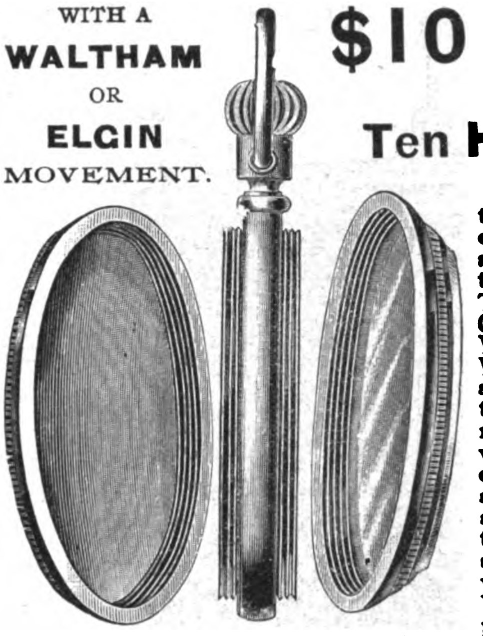

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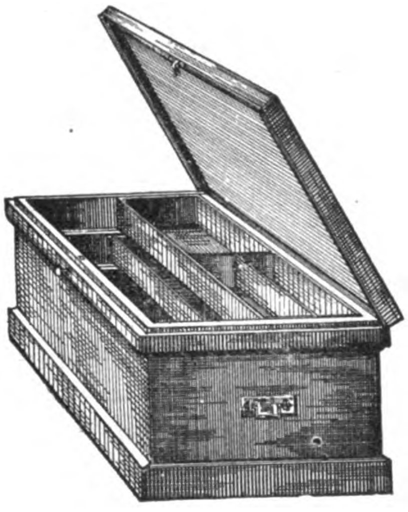

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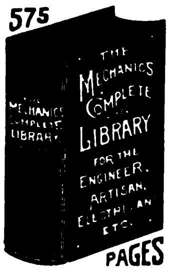
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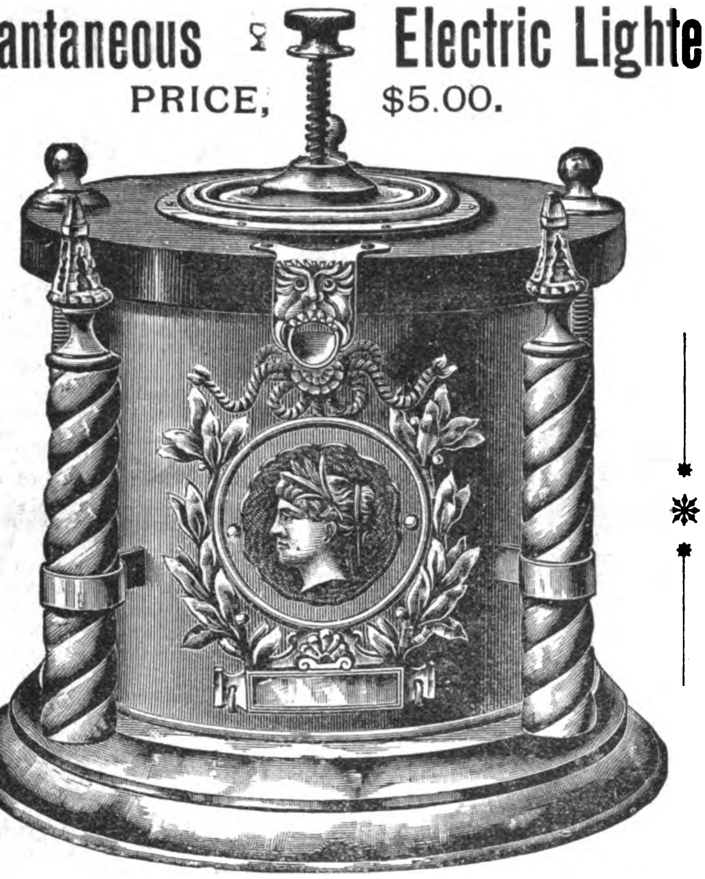

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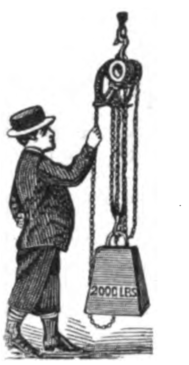

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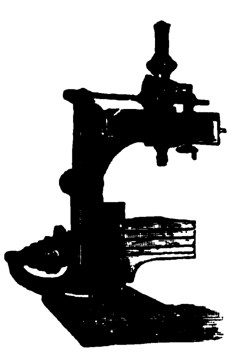

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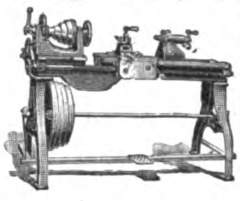

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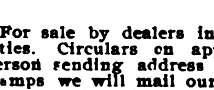

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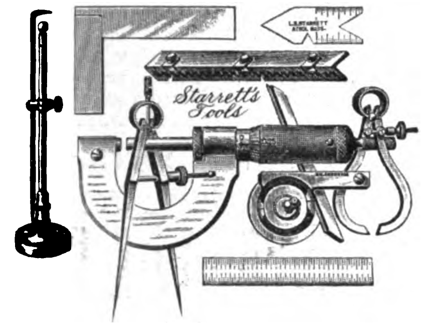

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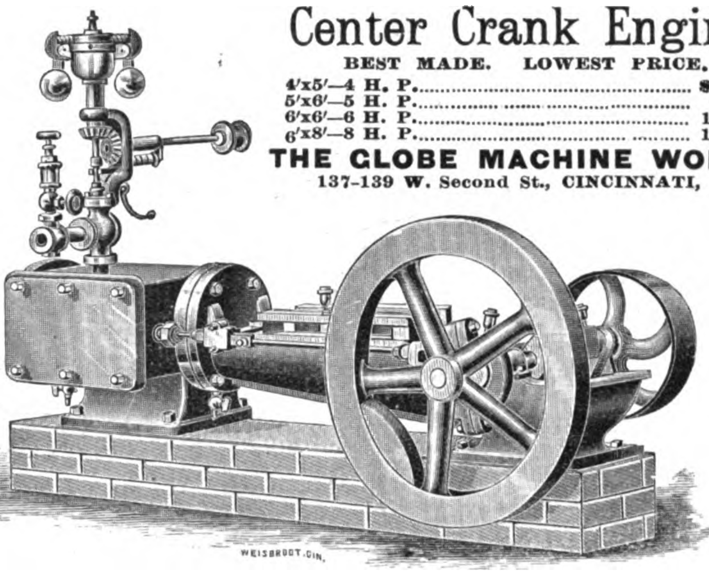
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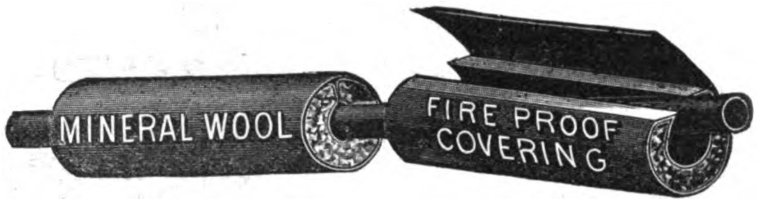

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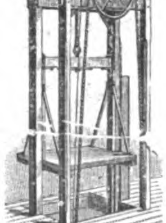

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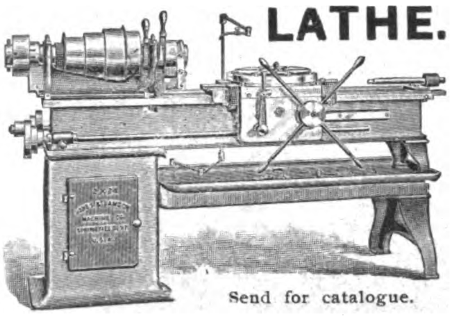

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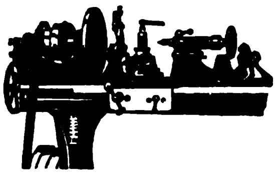

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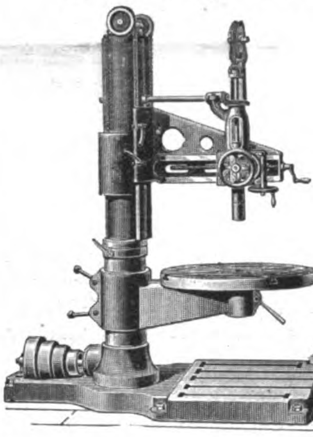

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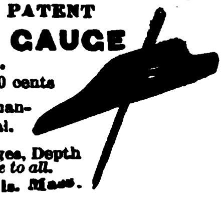

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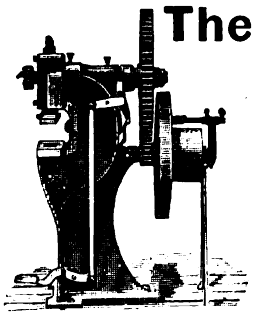

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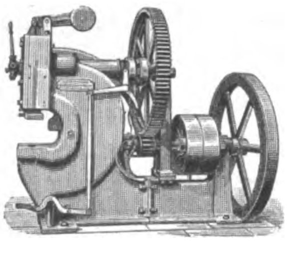

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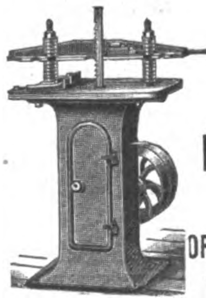

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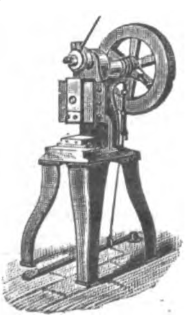

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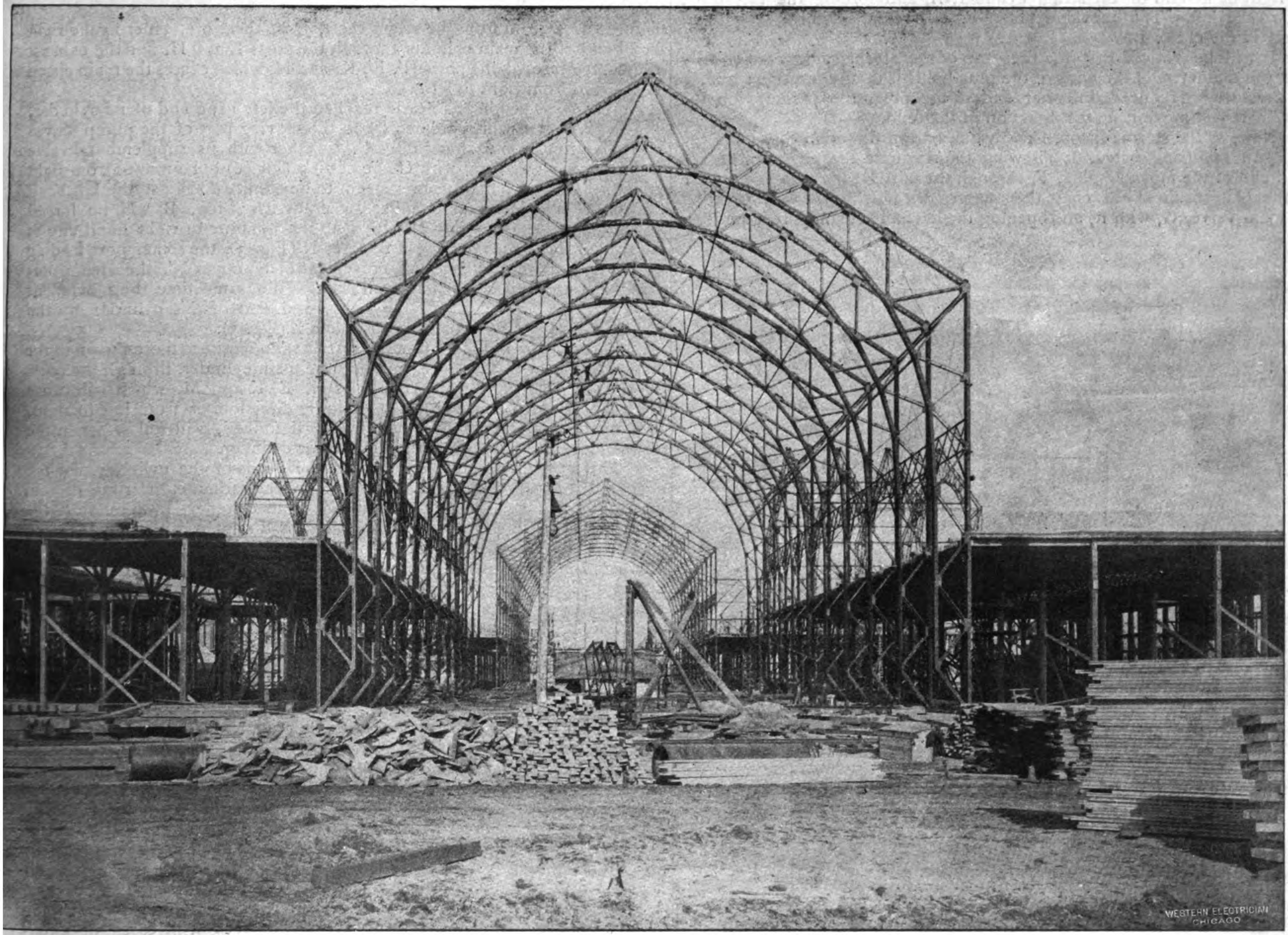
SCIENTIFIC MACHINIST

DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES

ESTABLISHED, 1882. CLEVELAND, O., MARCH 15, 1892. VOL. X—NO. 6. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. TERMS:—$1.50 A YEAR, SINGLE COPIES, 7 CENTS.

ELECTRICITY AT THE WORLD'S FAIR.

The illustration on this page, originally made for the *Western Electrician*, gives an excellent idea of the appearance of the electricity building at the World's Fair as it looked on the day when the photograph was taken—February 9th. Although work on this building has lagged somewhat in comparison with what has been accomplished on the other buildings now under way at Jackson Park, much progress has been made in placing the steel trusses in position. These arches form the skeleton of the great building, and an idea of their size can be gained by noting the com- arative minuteness of the men who were at work upon them when the hotographer took the picture.



PRESENT APPEARANCE OF THE ELECTRICAL BUILDING FOR THE WORLD'S FAIR.

Contractor Johnson's reports to the committee on grounds and build- gs show that 77 carpenters, 37 laborers and 32 iron workers are employed n the building. The lumber placed in position amounts to 2,639.809 et, and 28 trusses are in place, leaving only the center diagonal arches et to be erected, and for these the wood work is already in position. he contractor estimates that all the iron and wood work will be finished y May 1st. This however does not include the roofing, which is pro- ded for by a separate contract.

Engineering Notes.

A considerable partiality has for some time been shown by English ilders for the inverted triple-expansion, self-condensing marine engine. n the most popular type of this engine the three cylinders, high, intermediate and low pressure, are all bolted to and carried on cast-iron columns; the high and intermediate cylinders have hard, cast-iron liners, the high having the slide valve of the piston type working in a separate liner; and an ordinary double-ported slide valve does service on the intermediate cylinder, the valve of which is cast separately and secured by countersunk screw pins. The low-pressure cylinder has no liner, and is made of hard, close-grained cast-iron, with face of slide valve separate, and is secured after the manner of the intermediate pressure face, having the usual double-ported valve. The cylinders each have a hollow bottom, which is cast with the bodies, and the piston-rod stuffing boxes in each cylinder are made in separate castings and secured by bolts. The top covers and pistons consist of hollow castings, and in the cases of the high and intermediate pressure are fitted with Ramsbottom rings, while the low pressure has the Lockwood & Carlisle rings and springs. The piston rods, which are of the best hammered scrap, are carried through brass bushes in the top covers and run to a tapering end, to which the piston is secured by means of nuts and locks. The cross-heads are separate forgings, are fitted each with an adjustable cast-iron slipper with white metal lining, and are secured to the tapering end of the piston rod by a nut.

The practical use of air as fuel is declared to be a fact. As it is well understood by all, air is mixed with coal gas and with hydro-carbon vapors, and the compound, when burned, generates a much greater heat than if the air were absent. Coal, hydro-carbons, or what not, may be employed to give the initial incandescence, but once the blast strikes the luminous body the intensity of heat is secured, and may be maintained indefinitely.

STEAM PUMPS.—II.

BY J. C. SMITH, M. E.

In studying the action required of the steam valve of a single pump, it will be noticed that it is required to move when the steam piston has about reached the end of its stroke, or when it has about come to rest. The same relative action is also required in the steam engine, as the main valve must uncover the opposite port as the crank passes the center. The momentum of the wheel on the engine shaft is sufficient to carry the engine over this point, thus enabling the valve to perform its duty, and allowing the steam to force the piston in the opposite direction.

But, in a direct acting single pump there are no wheels nor other mechanism whose momentum would carry the valve over these dead points, so the pressure of the live steam in the steam chest is used for this purpose.

In all single pumps, this pressure moves the value directly, and its relative motion with the steam piston is governed by a supplementary valve, or other device, which depends upon the moving parts of the pump for its motion.

It would require a great deal of space to describe all of the devices of the many makers—for there are many—but, with a discription of two of the principal movements, and with some study on the part of the reader, any movement of single pumps may be analyzed.

Fig. 1 represents a longitudinal section of a "Cameron" pump, A is the steam cylinder, C the piston, D the piston rod, L the steam chest, F the movable plunger or plug, as it is often called, G the slide valve, I, I are the reversing valves, and K, K the covers over the reversing valve cylinders.

The operation of the pump is as follows: In the position shown, steam is being admitted from the steam chest, L, under the slide valve, G, into the right hand end of the steam cylinder, A, and forcing the piston C, toward the left. The movable plug, F, is circular in form, and fitted nicely in the chest, L.

It will be noticed that the pressure of the steam against the equally enlarged diameters of the ends of the plug holds it in any position; and, if the pressure be reduced on either end of the plug, the pressure on the inner part will move it in the direction of that end.

Now, as the steam piston, C, advances toward the left, it opens the left hand reversing valve, I, allowing the steam to escape from the left hand end of the movable plug, F, through the port E; the greater pressure on the plug inside of the chest then moves the plug to the left, carrying the main valve, G, with it, and opening the left hand steam port, admitting live steam against the left hand face of the steam piston. The steam on the right hand side of the steam piston passes through the right hand steam port into the right hand of the slide valve, G, through the exhaust port in the center, and then escapes into the atmosphere, the same operation taking place at the other end when the piston reaches that point. In order to move the reversing valve, I, back to its seat, a port, W, the end of which is seen in Fig. 2 (which is an enlarged section through the reversing valve) leads to the steam chest, L, thus keeping a high pressure upon the face of the valve, I, and which moves it back upon its seat as soon as the piston, C, is reversed. As the exhaust ports from the ends of the plug chamber are in direct communication with the atmosphere, there is no danger of steam accumulating at the ends of the plug from leakage, and destroying the balance of the plug, F, which would result in stopping the pump or reversing it prematurely.

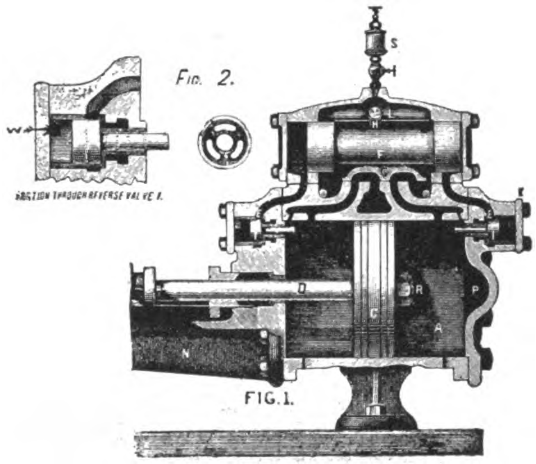


Fig. 2.

SECTION THROUGH REVERSE VALVE I.

FIG. 1.

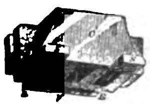


FIG. 6

FIG 5

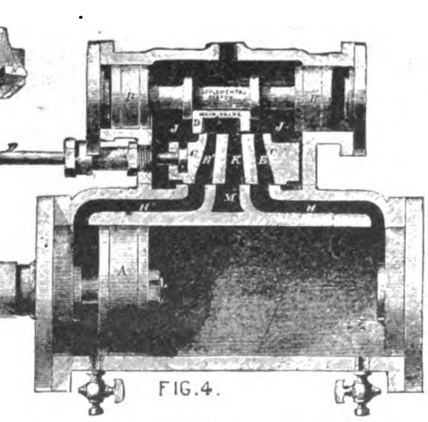


FIG. 4.

In starting a pump which is cold, a great deal of water accumulates from the condensation of steam, and, if the pump were started suddenly, and at a high speed, a great deal of damage might result from this accumulated water. To overcome this liability a starting finger, H, connected by a stem through a stuffing box to a lever outside and shifted by the operator moves the balanced plug at will, and directing the stroke of the pump, until all of the water is worked out, and the cylinder heated up, when the pump is able to take care of itself.

The "Blake" pump shows another design of valve gear for controling the admission of steam in single pumps, and is shown in Fig. 4. It differs from the previous one, insomuch as the steam moving the plug acts upon the ends and the admission of the steam upon these ends is controlled, not by tappets, but by a supplemental valve, which is moved by being attached to the moving parts of the pump.

The main valve, which controls the admission and escape of steam from the main cylinder, is divided into two parts, one of which, C, slides upon a seat on the main cylinder, and, at the same time, affords a seat for that part of D which slides upon the upper face of C. As shown in the cuts, D is at the left hand end of the stroke, and C at the opposite or right hand end. Steam from the steam chest, J, is, therefore, entering the right hand end of the main cylinder through the ports E and H, and the exhaust is escaping through the ports H′, E′, K, and M, which causes the main piston A to move from right to left.

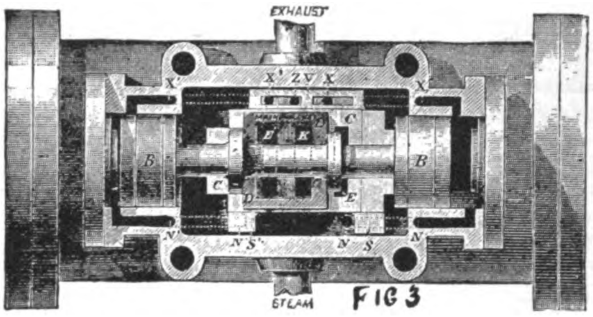


FIG 3

When this piston has nearly reached the left hand end of its cylinder, the valve motion which connects with the moving part of the pump moves the valve rod P, and thus causes C, together with its supplemental valve R and S, S′ which form with C one casting (Fig. 6) to be moved from right to left. This movement causes steam to be admitted against the left hand end of the supplemental cylinder, whereby its piston, B, will be forced toward the right, carrying D with it to the opposite or right hand end of its stroke, for the movement of S closes N (Fig. 3), the steam port leading to the right hand end, and the movement of S′ opens N′, the steam port leading to the opposite or left hand end; at the same time the movement of V (Figs. 3 and 6) opens the right hand end of this cylinder to the exhaust, through the exhaust ports X and Z (Fig. 3).

Ports C and D Fig. 4, now have positions opposite to those shown in the cuts, and steam is, therefore, entering the main cylinder, through the ports E′ H′, and escaping through the ports H, E, K and M, which will cause the main piston A to move in the opposite direction, or from left to right, and operations, similar to those already described, will follow when the piston approaches the right hand end of its cylinder.

The main piston, A, cannot strike the heads of the cylinder, for the main valve has a lead, that is, steam is always admitted in front of said piston just before it reaches either end of its cylinder, even should the movable plug, B, be tardy in its action, and remain with D at that end toward which the piston, A, is moving, for C would be moved far enough to open the steam port leading to the main cylinder, since the possible travel of C is greater than D. The movable plug B Fig. 3, can not strike the heads of its cylinders, for, in its alternate passage beyond the exhaust ports, X, X′, it cushions on the vapor entrapped in the ends of its cylinder.

The description of the above two valve motions embody the principles upon which all others depend; there are some constructions in which the supplemental valve is dispensed with in which a rolling motion is given to the movable plug which has steam and exhaust ports cut in it, corresponding to ports in the barrel of the movable plug, and, therefore, acting as a supplemental valve itself.

It is very often required to determine the size of a pump that is wanted to perform a certain amount of work, that is, to move a certain amount of liquid in a certain time, which is called the capacity of the pump, and also to find what size cylinder is required to move the liquid to a certain height or against a certain pressure.

In computing the capacity, a piston speed of 100 feet per minute is taken as a standard, although in some cases 90 feet is taken. The latter is, in the opinion of the author, better, as there is less liability to overtax the pump, and also leaves a reserve upon which to work it, in cases of emergency, although it calls for a larger pump, which means a greater first cost for the machine. In the present computation, 100 feet of piston speed per minute will be taken as the standard.

The capacity of a pump for ordinary service is usually rated in a certain number of gallons, or barrels, in a stated time, say an hour; and the computation relating to capacity concerns the diameter of the water piston only. All that is necessary to do is to take a convenient subdivision of the time in which a stated amount of liquid is moved, and find what amount is moved in this subdivision, adding 2 per cent. $\left(\frac{2}{100}\right)$ of this quantity for "slip."

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Then reduce this sum to cubic inches. Find the distance in inches through which the piston travels in that time, and divide the number of cubic inches delivered by the distance through which the piston has moved. This quotient is equal to the area of the water piston required, the diameter of which can be found by the ordinary method of finding the diameter of a circle, when the area is given; or it can be found by reference to tables in Nystrom, Häswell or other works, or, by reference to almost any pump maker's catalogue.

Example: Let us assume that the diameter of a water piston is required which will move 200 barrels an hour at a piston speed of 100 feet per minute. Assuming 50 gallons per barrel, we have $50\times200=10{,}000$ gallons per hour, or $10{,}000\div60=167$ gallons per minute; adding two per cent. to this quantity, we have $167+3.34=$ about 170 gallons.

A gallon measure (U. S. standard) contains 231 cubic inches, therefore, 170 gallons contain $170\times231=39{,}270$ cubic inches. Since the piston passes over 100 feet or 1,200 inches in one minute, we might conceive that the amount discharged in one minute filled a long tank, whose height is equal to 1,200 inches, and which contains 39,270 cubic inches. The bottom of this tank is equal to area of the piston required, therefore, $39{,}270\div1{,}200=32.7$ square inches, which is the area of a circle whose diameter is about 6⅜", the diameter of the piston required.

In the next we shall explain the method of obtaining the size of steam piston required to pump against a certain pressure.

ERECTING STEAM PLANTS.—II.

BY JAMES F. HOBART.

The temperature of a furnace should range from 1,400 to 2,000° Fah. The volume of air required to burn one pound of bituminous coal (together with products of combustion) is about 155 cubic feet. According to the remarks made above, this quantity of air exposed to the temperature of the furnace will make from 700 to 900 cubic feet for each pound of coal consumed.

From the above figures the area of the passage at the bridge wall required to admit this volume may be figured at from 2 to 2½ square inches, but in practice it is usually from 1½" to 1 6-10". Supposing that 20 pounds of coal per hour are to be consumed upon a square foot of grate, then 20 times 1½, which equals 30 square inches, are required and a like proportion for other quantities. Sometimes this matter is got at in another direction. When the area of the flues is determined upon and the area over the bridge wall is required, it should be taken at from seven-tenths to eight-tenths the area of the lower flues for natural draft, and from five-tenths to six-tenths for blast.

A good deal of stress is laid upon the value of carrying a thin fire. Some authorities state that coal to a depth of 12" upon the grate is more effective than a less depth. The same authorities state that the admission of air above the grate increases the evaporative effect, but diminishes the rapidity thereof. It has been found that air admitted at the bridge wall effects a better result than when admitted at the door; that when admitted in small volumes and in steam or currents, it arrests or prevents smoke. Air should not be admitted through a greater cross sectional area than four square inches for each square foot of grate.

From the hints and figures given above and in the previous paper, a mechanic should be able to sketch out a very effective boiler setting. Care should be taken that the grate is not too close to the boiler. Authorities differ upon this subject. Some claim that 36" is none too great for all kinds of fuel, and insisting upon about 40" for sawdust and other light combustibles. Still other authorities demand grates for coal placed at 20" to 24" from the boiler, and increase this distance but very little for wood, straw or sugar-cane refuse.

It will be assumed that the boiler is or has been purchased ready-made from some responsible manufacturer. The purchaser should insist that the boiler shell be made of a good brand of steel or iron. It is sometimes necessary to place the manufacturer under oath in order to make sure that the material is as represented, but usually a manufacturer is perfectly willing and ready to furnish good material, provided he be paid a fair price for the same. The use of poor material for boilers was caused by the purchasers of such machinery who insisted upon the cheapest possible figure, both for workmanship and for material. As it is partly the business of a dealer or manufacturer to supply in his line what there is a demand for, he is often forced in self-defense to sell the inferior material and poor work for which there is a call. There is, however, no excuse for a manufacturer to give poor boilers when good ones are called for, and it is to the credit of boiler manufacturers that few if any of them will do so.

When water and fuel per square foot of grate surface are given, it is necessary to compute the ratio of heating surface to the area of the grate in order to effect a given evaporation. Multiply the number of pounds of fuel consumed in an hour by a constant which is specific for each type of boiler. It will be about ten for stationary boilers. Subtract the product of these two quantities from the number of pounds of water to be evaporated per square foot of grate; then divide by a constant, which is 2-100 in this case, and depends for its amount upon the area of grate and amount of evaporation. After dividing by the last constant, extract the square root of the quotient, and the result will be the ratio of heating surface to the grate area.

(To be continued.)

SWEDISH papers describe a novel kind of construction, termed a locomotive steamboat, built at Kristanstud, for the navigation of a chain of small lakes, separated by falls, the boat being fitted for this purpose with wheels fitting a track, and power may be applied to either the propeller or the driving wheels of the locomotive part of the track; the latter is three feet six inches gauge, with grades of one in thirty-three, and having curves of a radius of one hundred metres.

Electrical

The Electric Motor of Fifty Years Ago.

Having, perhaps, taken too long a leap in our last article on modern machines, we now go back a few years and speak of some of the earlier movements in the evolution of the generator.

The first experiments with reference to electric motors were all based on the simple idea of magnetic attraction; that is, the power with which an electro-magnet would attract or draw to it a piece of iron or steel. Working on this line, large electro-magnets were made, and before them on suitable axes were placed wheels, or cylinders, having at regular points around their periphery bars of iron or steel. Connected with the electro-magnets by a switch or an automatic contact, was a battery, whose current passing through the magnets caused them to attract the iron or steel, thus revolving the wheel toward the magnet until it reached a point where the magnetic pull would simply hold it stationary. Just as this point was reached, the battery current would be shut off, thus killing the power of the electro-magnets and allowing the wheel to continue its revolution by its own momentum. The first iron bar safely past, the current was again thrown on to attract the second bar, and so on.

It will at once be seen that such motors, even if very large electro-magnets were used, would have comparatively small power; that large numbers of battery cells would be necessary, making a very bulky affair, and the action of the motor would be jerky and unsteady and the magnets, oftentimes not losing their magnetism quickly, would partially kill the motion generated by their first action. Many inventors spent large sums of money in this line of experiment, all of no avail.

A little in advance of the theories above mentioned, come practically the first electric motor. It was the invention of M. Jacobi, of Koenigsberg, and consisted of two rows of horseshoe magnets, arranged in circular form. Set between them on a horizontal axis was a wooden star-shaped frame on which was a row of iron bars, the current being applied so that the bars were attracted by one pole of the magnets and repelled by the other.

From a work on electricity as a motive power, by Count Du Moncel, we quote the following extract from an article, printed in "L'Institute," December 3d, 1834, in which Jacobi describes his invention. The extract referred to reads as follows: "M. Jacobi, of Koenigsberg, presented to the Academie, a paper on a magnetic engine of his invention, in which magnetism is employed as a motive power. The following is the description he gives of it: 'The apparatus consists of two systems of eight bars of soft iron 7" long and 1" in diameterr These two systems are placed at right angles, and so arranged on two discs that the ends or poles of the bars are opposite one another. One of these discs is fixed, while the other revolves on its axis, and the movable bars are thus made to pass as close as possible before the fixed ones. The 16 bars are wound with 320 feet of copper wire, one and one-fourth line in diameter, and the ends were in contact with a voltaic apparatus. The whole mass, moving with a speed of six feet per second, gives about 50 pounds, being a considerable *vis viva.* The work thus furnished, measured by an apparatus similar to the Prony brake, is equal to a weight of ten or twelve pounds, lifted one foot per second. This success is principally due to a novel construction of the commutator, by which are worked the changes of polarity, which takes place eight times in each complete revolution; that is to say, eight times in half or three-quarters of a second, the ordinary speed of the machine, when the water in the cell is so little acidulated that the development of gas is hardly appreciable.' "

Jacobi later used, for propelling a boat, a motor similar to the one described above.. Batteries were used to furnish current for the boat motor.

In 1844 Froment constructed a motor termed a "Crank Motor." The action was caused by the suction or magnetic attraction of the magnets on an iron armature which operated a pair of levers working on a connecting-rod and crank-shaft, thereby turning a fly-wheel somewhat as a grindstone would be revolved.

There were many other forms of motors built by inventors of that time, but those described above are typical motors of that period. Not until it was discovered that constant current induction machines could be used as motors, were any advantageous results obtained. As soon, however, as it began to dawn upon the minds of inventors that by a slight alteration the constant current generators could be utilized as motors, and that it was possible to deliver from the motor a large part of the current put into the generators, inventors turned their efforts in that direction. But for a long time work in the line of power transmission went slowly, until within recent years it had been caught in the tide of electrical progress, and we now have many economical and efficient systems of power transmission.

E. M. F.

AN improved steam pressure pump, capable of resisting a pressure of 700 pounds per square inch, is among the recent mechanical achievements. It is designed for such service as requires the delivery of liquids under considerable pressure. The plungers are connected together by yokes and exterior rods, in such a manner as to cause them to move together as one plunger, so that, while one is drawing, the other is forcing the fluid, thus making the pump double acting. The construction is such that the packing of the plunger is rendered not only entirely accessible in case of leakage, but different forms and material of packing can be resorted to. The valve boxes are subdivided into separate small chambers, easily accessible and capable of resisting a heavy pressure, and the general mechanism is such as to adapt the pump to different requirements.

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THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience experiments. Plain or and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

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CLEVELAND, OHIO, MARCH 15, 1892.

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PROTECTION FOR WAGE WORKERS.

That this nation is yet to pass through its greatest calamity, unless the people are aroused from their apathy and effectually throttle the evil of immigration, is certain, if any crisis in national affairs can be said to be certain before it has arrived.

We notice that Congress has adopted a resolution to investigate certain phases of immigration. It could scarcely do less. Let no one be deceived as to the results of that resolution. There will be none. Congress has investigated enough; the members have talked buncombe enough; the wool has been pulled over and dust thrown into the eyes of the people quite enough. It may as well be accepted as a fact that no Congress, Republican or Democratic, will ever correct this evil. It will not be done until a party is organized for the sole purpose of forcing the adoption of stringent laws.

Men who work for a living would do well to consider fully these facts. The time has come to break away from all parties that have proven recreant to their duty and trust, and to make a firm stand on the platform of the restriction of immigration. If they will unite on this one question, leaving all other issues out, the object can be accomplished. The workingmen can elect representatives to Congress in nearly every large city, and in a vast number of agricultural and mining districts. Why do they not do it? Capitalists look out for their interests, so do the middle classes, but workingmen let the politicians and moneyed men oppress them to the last limit of endurance before taking action. It is well to consider that the tremendous influx of poverty-stricken men and women within the past fifteen years can not be kept up without ruining American homes, destroying the individuality of the nation, converting our institutions into machines for corruption and practices poisonous to our healthy systems and subversive of our liberty and sound principles. Those who toil for bread will in such an event be brought to the beggary of European workmen through the competition of European paupers. What should you do, workingmen, when England spends tens of thousands every year transporting criminals to your land, to prey upon you; when the German Emperor announces his intention to keep all the able-bodied at home, and drive out all the depraved—pay their passage to America he means, of course—and when steamship companies are permitted to canvass Europe from Southern Spain and Italy to the Baltic inducing the poor classes, by the most outrageous lying ever known, to cross the Atlantic? What should you do when all nations, witnessing your greater prosperity, conspire to reduce you to a state of misery, and when your own Congress aids and abets them? What should you do when laws are framed preventing foreign manufacturers from selling goods in our markets, thus giving the industry over to home manufacturers, but at the same time permitting the pauper and degraded labor to come over here free of duty, to work in the protected manufactories at wages incompatible with civilization, and take the bread from your mouths? What should you do when there is a systematic effort made to drive out competition in production on one hand, and on the other hand to so increase the competition in the chief commodity of production—labor—as to greatly reduce its cost? You should organize, throw aside old party affiliations and elect men to Congress who will see that your interests also are looked after.

We are not endeavoring to incite you against protection, but to urge you to get some protection yourselves. There is no use thinking that any of the established parties will be scared into doing anything. They are both united in maintaining *statu quo*. Nothing but a party movement will preserve your wages and avert a worse national crisis than the country has yet seen.

HINTS TO ENGINEERS.—VIII.

BY EDWIN WOODWARD.

In assuming charge of an engine what is the first and most important thing to be done? This is one of the first questions that the learner asks.

A knowledge of conditions is necessary to make the query susceptible of satisfactory answer. If the engine be new, and carefully made, and properly put upon a good foundation, the "new" engineer will be laying a base for practical business by becoming so familiar with all the surroundings, that any change, or a sound, will arouse earnest care—the change followed up, located and removed—before his ease of mind is regained. It is not usually the case that a new plant is given into the care of a fledgling, and an experienced engineer usually has charge till all is working smoothly, and this plan should always be adopted. It will relieve the learner of much distress of mind, and usually a vast amount of labor and care subsequently, from an ignorance of certain causes and the effects produced—cylinders cut, slides creased, the valve or seat ruined, the crank pin burned, and a thousand other things to which a new engine is especially subject, and for which the beginner has no ready remedy, and what is still worse, no knowledge of the evil till it is done, but with which stopping the engine will stop the damaging—if experience affords no remedy.

The experienced engineer will not be confronted with these—unless as ghosts risen from his past—but the loose parts adjusted with care—not all at once—and oil will be freely used if it is needed (and it usually is somewhere) the supply being cut down when it can, and eventually the engine is turned over to his successor in good shape. Then the most important thing is for him to keep it so. If the learner is apt, he will soon be able to distinguish any irregularity, discover the cause, and right it.

Assume then, that the engine is in prime running order. The first then is to attend to the oilers and start them to feeding. It is now the practice of enterprising builders to use stationary oilers with sight feed—the moving part catching the drop on "wipers." The sight feed is a valuable feature, and consists usually of two holes drilled in the shank of the oiler at right angles with each other. A tube is let down from the cup to the centre where these holes meet, and the amount of the feed can be nicely regulated, the drops being visible. Most cylinders are lubricated with an automatic sight feed lubricator, of which—aside from those kinds which are positive, inasmuch as they are connected with some moving part of the engine, oiling when at work, when idle not, there are two classes—the one feeding up through a column of water, the other the drop falling down—no water. Of the first a little more care is needed in its manipulation. In filling, steam must be shut off from the cup and the water in it let out of the vent in the bottom. Before this is done close the valve that regulates the supply of oil that the water in the sight-feed tube may not also get out, and if by any chance the water in the tube is lost, do not attempt to feed oil, till the glass is condensed full again.

After filling and the plug replaced, turn on steam, and start the feed—allowing the valve and piston as many drops per minute as will keep them working freely and smoothly.

Of the class which feeds down, no attention need be given to the feed valve when filling, as there is no water column to maintain, merely shut off the steam, let out the water, fill, plug, and let on the steam. The feed requires no care except to see that the supply is in accordance with the demand.

If the engine is exposed to low temperature, the necessity of relieving the cup of water is apparent. Have the drip cocks to the cylinder open for the same reason. In cold or frosty weather a vast amount of water will condense in the lead pipe, while steam is being raised, if the pipe is not covered, especially if the engine is at some distance from the boiler—as it nearly always is. The water so condensed must pass into the steam chest, thence into the cylinder, and from there out at the exhaust, if it finds no other means of exit. To avoid the danger that must arise from such a condition, it is advisable to open the throttle slightly, several minutes before the engine is to be started, that the water may pass away and out the cylinder drips or from the steam chest. This also warms up the cylinder thoroughly, all parts are equally expanded, the condensation of steam is much less than if the cylinder walls were cold, and the engine will run smoothly much sooner, since the piston does not pound water at each end.

If the engine is in position to start, have care that very little steam is admitted—if more is coming than can get away, the surplus accumulating will ultimately start the engine, if it but pushes it over to the next center. This seeming trifle has been the cause of much damage and serious accident. No one knows the harm that such an unexpected move may do, and the engineer that carelessly permits such to occur should be subject to a severe reprimand for the the first offense, with discharge in store for the next. If the engine is in a position where the steam is cut off, of course full boiler pressure admitted will not start it. But even then heavy pressure should not be admitted. Laborers at work with other machinery might turn the engine over the center to find a death trap, and, if escaping, the engine stands a fair chance of a wreck. The short of the matter is: Take no chances with steam. Be its master. It is easily handled when under control.

When handling small or medium-sized engines no thought is given to stopping them where they will start from the simple admission of steam. If not in position to start readily it can be turned over by means of the fly.wheel, but with larger engines it is quite another matter. The inability to turn such a heavy mass over, or the absence of a detach valve gear and starting bar, makes the matter of stopping right very important. The art is readily acquired. Shut off the steam, and when the engine is checking up calculate where the momentum will carry it, having the throttle in hand if the engine is likely to stop on the center, or after the steam is cut off, admit sufficient steam to carry it over. After a few trials the work becomes very easy. It is usually possible to start the engine when the steam is nearly cut off by throwing on full head at once. After the first impulse it should be immediately shut off to be caught up again after the center is past. On account of the strains of such sudden exertion it is advisable to stop in a more suitable place. If the valve gear detaches, after admitting steam, unhook the eccentric rod and with the starting bar move the valve so that the best effort may be made on the piston, dropping the rod again in position when the eccentric allows. After the engine has had time to clear the cylinder of water, close the cocks—these should have couplings to connect it to a waste pipe, especially if the engine is indoors. Then, as before stated, the engineer can devote his attention to the task of learning the usual accompaniments of good running.

It is seldom one's lot to meet with uninterrupted good fortune through life, and the engineer is no exception, and if he sees disaster coming with warlike intent, it is his duty to throw up such breastworks as will keep the enemy at bay. If a leak of steam shows a weak joint and liable to open, draw it tighter, if the bolts will admit. But a leak in a joint is only amenable to such treatment when first made up. When it is old and inelastic the first evidence of failure is a signal that the packing should be renewed next morning.

Leaking joints soon give the engineer a reputation for shiftlessness, but if the leak is in the stuffing-box of the piston or valve rod, it may be due to the gland coming loose. With these care should be taken to screw up alike all around. If one side is faster than another the gland will be in a twist, will bind and perhaps break, but worse, if it is long enough to give reasonable depth to the stuffing-box, the binding will come largely on the rod and it will be worn and scored where it should be the most perfect. So, great care should be taken to adjust it evenly, and the packing should be distributed with mathematical uniformity on every side.

Steam may leak by the piston rod, no matter how perfectly packed, if the rod be not parallel with the ways and cylinder. When assembled they are in line, but in the course of time wear takes place in the cross-head which, when taken up, if not done with an eye to having the rod central again, the latter will either be raised or lowered at the cross-head, dependent on the way the engine runs—whether over or under. This condition of the rod not only makes it impossible to pack the rod to prevent leaking, but makes the friction and wear excessive on the slides, cross-head, piston rods, and rings, as well as the cylinder. To illustrate: If the engine has a 24" stroke, and the cross-head is 8" from the stuffing-box where nearest, then if the piston rod is one-sixteenth of an inch low at the cross-head, the piston would be three-sixteenths high, if the cylinder did not hold it to place.

Certainly while there is great friction and wear in the cylinder and guide-bars, the impossibility of having steam tight packing on the piston-rod is apparent to any of the five senses. If the rod is not in line, remove the packing from the stuffing-box and turn the engine over to the outer center, then raise or lower the rod at the cross-head, as the case may be, till both ends are of equal height from the slides. Then if the rod be straight and smooth it is no difficult task to hold the steam.

IN AND ABOUT THE SHOP.

Well, John, I have been trying to get round to the engine room for the past week and see what kind of a man and what kind of an engine we had driving this place, but have found so many other things of interest to examine that I could not do it.

Looks rather dark and dirty in here; think a coat of whitewash would not do any harm. Do you? What is the matter with that little steam pump, that it wheezes so? Has it got asthma? I suppose you have things down pretty fine in here in the way of economy. The steam valve in that steam chest must be a monster. One thing encouraging is to be seen and that is, the builder of that engine was not one bit stingy with his iron when he built that one. How do you like her, anyway? You don't like her; she is a regular old gormandizer on the coal question; the packing is worn out, so are the brasses in the main rod, the valve seat leaks steam like a sponge; that old worn out steam pump used for a boiler feeder is one thousand years behind the times and everything but the boiler ought to be put up for junk. Well, I must admire your candor, anyway, in expressing so poor an opinion of the machinery under your charge, but I would not throw up my situation right off on the strength of it if I were in your place.

Do you know how to use the indicator and how to work out the diagrams taken from it? You do. Do you know where there is one? You say the firm bought one two years ago and paid less than a million dollars for it and it was so valuable that they have kept it locked in the safe ever since? Well, evidently they knew a good thing when they saw it and want to take care of it. We will get that indicator out and I want you to get a pair of scales and then I want you to give me an estimate of the cost of a new engine of best design for saving fuel, also the cost of a new and reliable injector for that boiler. Show me how much coal you will save and how much more efficient the power will be. In fact, just suppose that I don't know a thing about it and you want to convince me that it will be to my interests to have all these things. See? All right. I will come 'round after it in three weeks. That will give you plenty of time to "monkey" with the indicator and get real well acquainted with it. Good morning.

Buying an indicator and keeping it locked in the safe! Some people have queer notions of economy. Just like my good old grandmother, who used to buy a bottle of cough syrup and then allow us youngsters to "coffer-dam" (heads off) while she "saved the syrup." "Official" mechanics can make practical common sense hang its head clean down between its kness in shame sometimes. Appearances seem to indicate that I am going to have more to do "managing" the members of the firm than I am the employes and the machinery.

THE OLD MAN.

LEARNING TO BE A STATIONARY ENGINEER.

BY J. H. ORAM.

In order to become a stationary engineer the first and most essential point is a sound, common school education; a thorough knowledge of arithmetic and practical geometry to understand calculating the area of all plain surfaces and the cubic contents of all bodies, and a knowledge of natural philosophy, so as to understand the natural consequences of the various operations that take place in the engine-room. To these may be added mechanical drawing and algebra, and an elementary knowledge of chemistry.

It is not, however, necessary for a young man to know all these things to begin work, though the more he knows the faster he grows, but having what foundation he may he can, if so inclined, put any and all of these superstructures thereon.

Nor is it to be understood that these subjects are to be mastered to the fullest extent. Nevertheless such a knowledge of them as is absolutely necessary to become in every sense a first-class engineer is within the reach of any young man who desires to attain it rather than spend his spare time loafing. Few realize how much knowledge can be gained in a few years by one or two hours study per day, and few indeed are the young men who cannot devote that or more time to so worthy an object, if they will, remembering that "present privation means future prosperity."

It may as well be understood that no uneducated man can become even a very indifferent engineer, when the duties required of him at the present day are taken into account. Let me say further, I believe the day is near by when the mechanical engineer will be classed among the professions rather than the trades.

It is most important to impress upon the minds of boys who desire to become engineers that when possible they should take a two years' course in a technical school, in which case electricity may be studied with profit; nor is it the intention to ignore electricity in the course here prescribed, as it is fast becoming, nay, has become, one of the essential branches of the operative engineer's knowledge. However, this paper is intended to keep within the limits of the engine and boiler rooms. It is to be regretted that often a bright boy is compelled, through force of circumstances, to earn his own living when he ought to be at school, but should he be fortunate enough to possess the advantage of a course at an institution of applied science, the two years' apprenticeship in the machine shop, hereinafter mentioned, may be omitted.

We will assume that the young man either has of necessity to work to get his living or that he has completed a course of technical education. Then the first place to get a start for practical knowledge is the boiler-room. Procure a job as fireman, if possible, or greaser, in the engine-room, but should the apprentice start as greaser, by no means neglect to get a thorough knowledge of firing and care of boilers, at the same time closely observing every operation in the engine-room which comes within notice.

Two years at this kind of employment generally make a young man feel as though he ought to be classed as an engineer, but still he has an apprenticeship to serve (provided he has not graduated from a school of applied science) if he would be an engineer.

Before a man can be trusted with the care of machinery, he must know how to handle tools and to know this a term in the machine shop is necessary. There are in all cities repair shops, and such a place is preferable to putting up new work, there being more variety as well as the experience of seeing the effects of wear and tear, and not a little of the consequences of ignorance in the engine room. Remain on the floor and at the vise. The engineer has very little use for operating a planer or lathe in the engine room, and every vise-hand can get a good knowledge of the machine hand's duties, while the art of handling tools takes practice. Now, having served two years longer at the machinist trade, except as in the case hereinbefore mentioned, procure a situation as second or assistant engineer, and during these four years any man of fair education, having diligently applied himself, will have accumulated a very valuable stock of information.

Besides the branches already mentioned, mechanical works should be studied, especially as a reference library, to get the fullest possible theoretical knowledge of the practical work on hand. Some are specially written for the young engineer and are very helpful in getting a knowledge of terms used. Periodicals devoted to the interests of steam users will also aid in many ways, especially in keeping new things before the mind.

Now one year under a good engineer will constitute a five-year apprenticeship and will, under all ordinary circumstances, produce a man sufficiently educated in his profession to begin practice on his own account, and I venture the opinion that few indeed can master the calling in less time and be in the true sense an engineer.

Further, be an attentive and respectful listener to men of experience and don't try to parade your superior education before men who have grown gray in the service; the knowledge they possess has been got by long experience and hard work, and they won't be dictated to by the boy. If you wish to make a suggestion or ask a question do it respectfully, and you will reap a rich harvest of knowledge from men who have been years in the business, although they may know little or no theory.

Let no young man be discouraged because of the great amount of knowledge claimed necessary to success. What calling or profession is there which commands a high salary and general respect which does not require hard study and work? And in our noble calling there is no royal road, but the goal is worth reaching—is both honorable and remunerative.

Practical Letters.

Perpetual Motion.

EDITOR SCIENTIFIC MACHINIST:

I would like some of your readers to give me information in regard to attempts at inventing perpetual motion. How many years since the subject first attracted the attention of inventors? A short history or description of the inventions that seemed most nearly to approach the principle, with the names of the inventors, the number of applications filed in this or in all the patent offices of the different nations of the world. INQUIRER.

An Electric Lighter.

EDITOR SCIENTIFIC MACHINIST:

Will some reader of the MACHINIST kindly give me advice on an electric cigar lighter? My idea is to take the two ends of incandescent negative and positive wires and attach them each to a brass strip. There should also be a lamp on the wires for safety. Then have an alchohol brush put in between the two brass strips, and I believe it will light. If any reader can give me a better way to make an electric cigar lighter, I will be much obliged to them. A. M. S., N. Y. City.

Arranging Gears.

EDITOR SCIENTIFIC MACHINIST:

Herewith is another answer to question 314, of H. F. M., Gypsum City, Kan.:

You can not cut 17 threads to the inch with the set of gears you have. The nearest you can come to it is: 24 × 48, will cut $17\frac{1}{7}$. 52 × 88, will cut you $16\frac{12}{13}$. Either of them may be near enough for your purpose. I would advise you to order from Barnes & Co. three more gears 33, 34 and 35, then you can meet any emergency. Engine lathe builders should make it a rule to advance in one step of the range of gears by one tooth only, instead of advancing in a regular order of four or six, as the case may be. CHAS. MILLER.

The Uneven Planer Table.

EDITOR SCIENTIFIC MACHINIST:

It strikes us that you may have misunderstood the question of "Reader," No. 330. Any planer table will become high in the center from natural use. It is caused by the constant knocks and blows it receives from castings, bolts, etc., thereby stretching the upper surface. A proof of this is found in truing up the table. We find that after taking a cut over the table and reversing the surface the conditions are reversed and the table is low in the center. It will then be necessary to take another cut in order to leave a true surface. Or, if the table is already as light as it is desirable to have it, we may turn it over and plane it on the underside with a hammer until we find, by applying straight edge to the face, that we have obtained a true surface. RAY, Torrington, Conn.

Where the Pound was Found.

EDITOR SCIENTIFIC MACHINIST:

Seeing that you invite all your readers to communicate to each other their trials and experiences in their different mechanical pursuits, through the columns of your paper, I will relate a little incident that happened to me, the other day. I have charge of the engine and shafting of a roller mill, and on starting up one morning I noticed a pecular jar or thump. I examined the engine all over, and decided it was not there. But I made another examination that night, took up a little "lost motion" and adjusted some of the bearings, fully expecting to find the jar "knocked out" the next morning. But on starting up again it was as plain or worse than the evening before. To say I was puzzled would be putting it lightly. I was just on the point of writing to the SCIENTIFIC MACHINIST for aid, when, on going into the basement of the mill house, I happened to see one of the bracket post journals that supports the line shaft shaking, and on examining it I found it was very loose, also three other ones, in the same state. I gave each a dose of the "monkey wrench," and since then all traces of the jar have disappeared. The line shaft, I forgot to mention, was connected to the crank shaft by a common coupling, making the shaft solid, and conducting the sound of the loose journal along to the engine. Now, if you think this might possibly be of any service to any one situated as I was, you can print it.

I would not be without your valuable paper for twice what it costs. I am not a very skilled engineer, but if I see this in print, which will convince me that the editor considered it of some value, I may come again some day. So hoping to hear from every one that can give any information that will help us engineers along with our work, especially young fellows, I am, Yours respectfully, J—— K——a.

A NEW WORK ON GENERAL MECHANICAL SUBJECTS.

"The Practical Catechism, a collection of questions on technical subjects, by manufacturers and others, and of answers thereto," by Robert Grimshaw, M. E., Ph. D., is a little work about 300 pages, recently brought out by John Wiley & Son., 53 E. 10th street, New York. The questions cover a wide range of inquiry, and will be found very useful to the manufacturer in general. The receipts alone are worth many times the price, which we understand to be $2, in cloth.

As an instance of how subjects are taken up and discussed, we quote below from the catechism under the head "Power."

Q. What are the items which enter into the cost of steam power?

A. Interest on the cost of engine, boiler, chimney, boiler room and engine room; wages of engineer and fireman; insurance; taxes; a portion of the wages of general foreman and manager, repairs; sinking fund for redemption of cost of boiler and engine.

Q. What is the proportion of a man-power to a horse-power?

A. That depends upon how the man applies his power and for how he has to apply it; also upon whether you compare man-power with the ordinary, conventional horse-power of 33,000 pounds, elevated one foot high in a minute, or with the actual work of an average horse.

A well fed and well treated horse weighing half a ton can pull with a traction of 100 pounds at the rate of 2½ miles per hour, for ten hours, upon a tow path; or he can exert a traction of 200 pounds for five hours at the same rate upon the same road; or he can pull 125 pounds at the rate of two miles an hour for ten hours, upon the same road. The useful paying daily net work of a horse in hoisting by a common gin, is about 10,000,000-foot pounds.

Now you have the two standards of horse-power, the actual and the conventional.

A practiced laborer hauling along a level road by a rope over his shoulders can do about one-sixth as much as the horse; but if he is turning a crank, so that he has to bend his body, etc., he can do only about 115,200-foot pounds, including rests, per hour of time; and there will be a loss also by reason of the friction of the machinery, which will bring his work down to just $\frac{1}{10}$ of what a horse will do. On a treadmill a man will do 40 per cent. more than at a crank; that is, in ten hours, including rests, he will do about 1,400,000 foot pounds. By a good, common pump, a man can, in ten working hours, raise 1,000,000 foot pounds of water, net. By walking backwards and forwards on a lever, which rocks on its centers, he can do more than by any of the modes before mentioned; Robison quoting his work done in this way as nearly $\frac{4}{10}$ of the net daily work of a horse in a gin.

Q. How can one figure the number of times a crane handle will have to be turned for every turn of the chain barrel to hoist a certain weight?

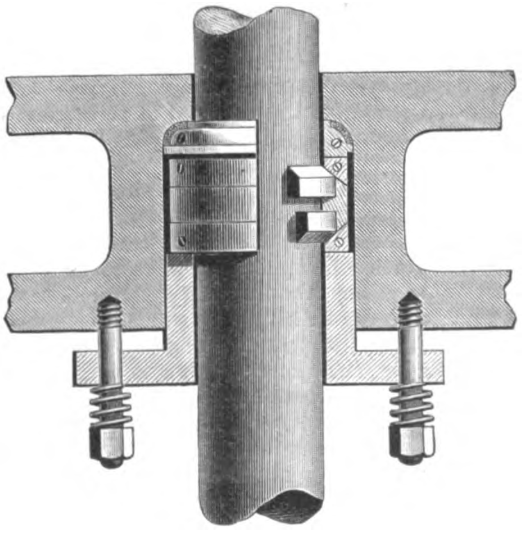
A. Multiply the weight (in pounds) by the diameter of the chain barrel (in inches) and divide by the diameter of the circle described by the handle (in inches), and by the power of the handle (in pounds). Thus: Suppose weight 1,000 pounds; barrel 10", crank 16" radius=32" diameter of circle, and power of one man on the handle in pounds, 20; then the crank must make $(1{,}000 \times 10 \div (32 \times 20) = 10{,}000 \div 640 = 15.59$ turns for every one of the barrel, or practically 16 to 1.

FORREST'S SILVER BRONZE PACKING.

A new metal packing that has now been sufficiently tested to enable us to present it with confidence is known as Forrest's silver bronze packing. It is the invention of H. E. Ferrest, of New York.

The principal feature is the *silver bronze rings* that go next to the rod. This metal is especially adapted to the needs of a packing material for constant contact with the hot rod with high speed. The only parts that wear away are these rings, and they can be renewed with an insignificant expenditure of time and money. The automatic features are very important, as all who have used packing on marine engines know.

The accompanying cut shows a sectional view of the packing in place. It forms a valve at the bottom of the stuffing box, preventing the steam or water from escaping around the outside of the packing, and closes around the rod, preventing leakage from the inside of the packing, the whole packing being held intact on the rod and kept seated by the gland, which is actuated by springs placed on the studs outside of the gland, maintaining a uniform pressure and following up the wear automatically.



The first brass ring in the bottom of the stuffing box is the seat ring; it is put in independently neatly fitted to the bottom and walls of the stuffing box and grooved out on the bottom to hold the Usudurian gasket, in which it is imbedded to make it tight. The next brass ring, the valve ring, is ground on to the seat ring, thus making a tight valve joint. This ring is made from one-eighth to one-quarter of an inch smaller in diameter than the stuffing box, to admit of lateral motion without touching the walls of the stuffing box. The rest of the packing, as shown, is of the same outside diameter and free to move in accordance with the vibrations of the rods. The cap ring, the outside ring next to the gland, is the same shape as the bottom ring (valve ring), but does not require to be tight at the gland. This ring slides on the gland laterally in the same manner as the valve ring slides on the seat ring, to accommodate the vibrations of the rod. The two inner rings next to the rod are the silver bronze rings, and take all the wear, and when these rings are worn out they can be renewed, making the packing as good as new without providing any other new parts, as all the rest lasts indefinitely.

The two silver bronze rings are held against the rod by a case made of soft yellow metal.

The case and bronze rings are each put in in two pieces, placed so as to break joints, are provided with suitable dowels to prevent registering, and may be put in and taken out in less time than any other packing.

The seat, valve and cap rings are screwed together around the rod, and never have to be disturbed to renew the packing.

Some of its strong points are: It is applicable to any ordinary stuffing box without change of gland. It can be applied to any rod without disconnecting. It is perfectly steam, air and water tight, without the use of soft or fibrous packing. It does not touch the walls of the stuffing box, so cannot bind or crowd the rod. Nothing but the rings of silver bronze wear away.

Probably no better description of its chief merits could be given than to quote from a letter, to the company that makes it, from William McDonald, engineer of the double-screw ferry-boat, "J. G. McCullough," which plies on the North River, N. Y. Mr. McDonald, after using this packing ten years, says:

"Your packing holds water and steam under high pressure without requiring any soft packing to help it out, and without the usual severe friction of other metallic packings under high steam. In my opinion, one of the best features of your packing is its automatic action—for since it requires no attention or adjustment, the liability of its being screwed up too tight is entirely removed, and the danger, common to other metallic packings, with which I am familiar, of melting them out, or heating the rods, is avoided."

J. H. Perry, chief engineer of the "Monmouth," a large boat of the Central R. R. Co., of New Jersey, also tells of his experience with it as follows:

"In reply to yours requesting me to inform you how your 'silver bronze packing' has been working in the engine of the Sandy Hook steamer 'Monmouth,' I take pleasure in stating that, notwithstanding the severe test to which it has been subjected, it has done the work perfectly, without using any fibrous packing whatever.

"Before applying the 'silver bronze packing' we were using the latest and most approved metallic packing, put in by the builders, Messrs. Cramp & Sons, but although this packing was supplemented with soft packing, which was removed almost daily, we were unable to stand on the working platform or feel of the journals below, without being scalded with steam or water. Since you put in the 'silver bronze packing,' two years ago, we have had no trouble and the boxes have been steam and water tight. I was favorably impressed with your packing when I first saw it, but it has exceeded in excellence my most sanguine expectations."

W. L. Hoffecker, Sup't Motive Power for the road that owns the "Monmouth," also says as follows, in a letter to the company:

"The steamer 'Monmouth' has been using it for the past two seasons with entire satisfaction. I examined it a few days ago and found it in good order and condition. We are also using this packing on our electric light plant engines at Jersey City. These engines make 370 turns per minute and without the slightest leakage of steam or water. I am having under consideration the adoption of it for our other steamers, putting it on this Winter."

This packing is manufactured by the Forrest Silver Bronze Packing Co., 115 Liberty street, N. Y. If the reader is interested in packing, it will pay him to write them for further information which will readily be furnished free of cost.

How to Make the 100-Mile Flyer Safer than a Horse Car.

Chas. R. Deacon's "One Hundred Miles an Hour" in the March *Lippincott's* has this interesting paragraph about fast flyers:

"The prevailing ideas regarding railway speeds are very erroneous at any rate. The majority of people, even the most intelligent among these who habitually travel, obtain their conceptions of speed from the figures of the time table, forgetting that in nearly every instance considerable portions of the route must be traversed at much less than the average rate required to cover the total distance in the schedule time. There are very few, if any, of the fast express trains which do not on some part of each 'run' reach or exceed a speed of a mile a minute. Yet, by reason of superior railway and well-constructed cars, the accelerated velocity is unnoticed; while running at from 60 to 70 miles an hour the passenger calmly peruses his newspaper or book, children play in the aisle, and a glass brimful of water may be carried from one end to the other of the smoothly-rolling coach without spilling a drop.

"Would faster trains be dangerous? No. In the history of railroads no instance can be found where a train has been derailed by reason of running at a high rate of speed. There is no more danger, intrinsically, at 100 miles an hour than at 40. The dangers to be guarded against bear little or no relation to the question of speed. The strict supervision of the tracks and bridges, the abolishment of crossings at grade, the fencing in of all lines of railway and the prevention of trespassing thereon—safeguards for the guidance and protection of trains—these requirements met, the 100-miles-an-hour 'flyer' will be a safer conveyance than a city horse car."

Maine Again a Manufacturing State.

Maine's record for new enterprises the past year is a good one, and shows some active work on the part of her enterprising business men. Over 100 new manufacturing industries were established during 1891, not including a large number of small ones, which are capable of enlargement. This is an encouraging sign of the growth and development of New England industries, and is very creditable to the citizens of the Pine Tree State.—[Manufacturers' Gazette, Boston.

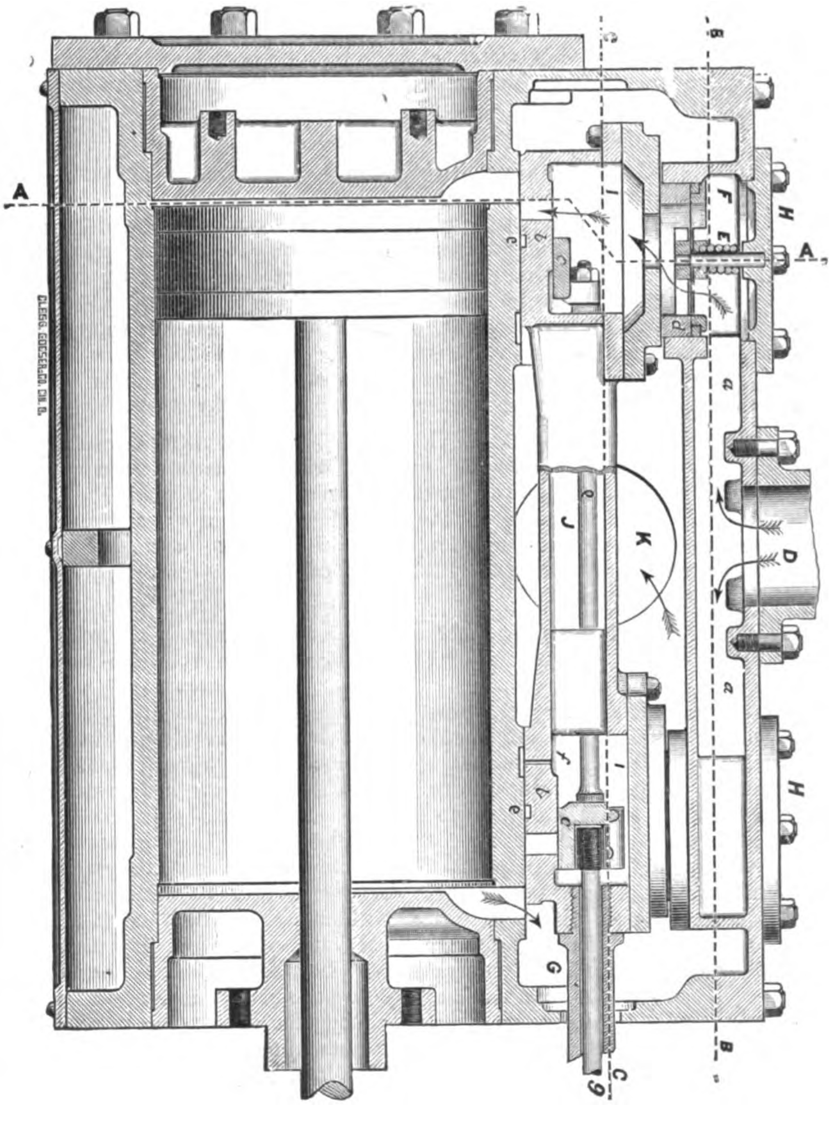
In a new lubricating cup for cross heads, wrist pins and other moving parts of a steam engine, the oil is supplied by means of a ball suspended from the top of the chamber, and swinging back and forth with the motion of the engine over the outlet in the bottom, forcing a little oil through on to the pin each time. The flow of oil may be regulated by means of a thumb screw on the top of the cup which raises or lowers the ball.

The Manufacturers' Club, of Philadelphia, desires to erect a building in the Exposition grounds, in Chicago, constructed entirely of material made by members of the club, with intent that it be headquarters for manufacturers, not only of Philadelphia, but of the entire country.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(341:) T. J. H., Cincinnati, O., writes: "Will you please publish in your next number a description and explain the working of the valve of a Buckeye automatic cut-off engine? By so doing you will oblige a young beginner." *A.*—The illustration shows a central section through the cylinder and right hand end of the valve and chest, the other end being a section through one of the balanced pistons. The steam enters at D, into passages *a a* which lead to balanced pistons *d* through which it passes to the interior I I of the valve, as shown by the arrows, in which chambers the boiler pressure is constantly maintained when the engine is at work.



The balanced pistons are packed in their orifices with steam-metal sprung rings and followers F, and also fitted to work steam tight on faces on the cover plates of the valve, thus forming a steam-tight communication between passages *a a* and the moving valve. Coiled steel springs E serve to hold the pistons to their seats on the valve when steam is shut off. From the interior of the valve the steam is admitted to the cylinder through ports in its faces, as they are alternately brought by its movement to coincide with the cylinder ports. The valve is shown as just beginning to admit steam at the left hand end as shown by the arrows, while at the other the cylinder port is shown partly opened for the exhaust, which passes into the chest and thence into the pipe K, at its bottom, its course being also indicated by arrows. The cut-off valve is formed by two plates, shown at *c c*, rigidly connected by rods *q*. These plates work on seats surrounding the valve ports, which ports they alternately cover at times relatively to the piston travel, determined by the governor. The area of the balanced pistons is such as to hold the valve to its seat against the force, tending to throw it off, due to the pressure in the valve and cylinder ports. This tendency is variable, being greatest at the moment of induction and least after cut-off, while the counteracting force due to the area of the balance pistons, is constant, and consequently in excess—except during induction. To counteract such excess, shallow recesses corresponding to the cylinder ports in shape and area are formed in the valve seats near their inner margins. These recesses or "relief chambers," as they are called, are filled with steam pressure from the interior of the valve through small holes, as shown at *f* at right hand end, while the port at the same end is open for exhaust and relieved of such pressure by the movement of the valve, as shown at the left, a little before induction. By this device the average pressure of contact is reduced to about what is needed to insure wear enough to keep the surfaces in good condition as against corrosion, etc., and at the same time better lubrication of the surfaces is secured. Channels E E are cut across the valve faces near its ports, to prevent the steam in the ports from acting on any larger area than is embraced in the balanced pistons, and thus throw the valve from its seat. To perform this function they require to be of such capacity and the free escape of any steam that may leak into them to be so well provided for that no pressure in excess of that in the chest can be formed in them. These conditions are attended to in the construction of the engines, but since wear from the valve faces reduces their depth, cases may occur of their becoming inadequate from long wear, so as to require deepening, or otherwise enlarging.

(342.) "Engineer," Lebanon, Pa., asks: 1st. "Can you give me a table showing what volume of air will pass through openings of different sizes under different pressures? 2d. How many cubic feet of air will pass through a hole 1" in diameter, the air being taken from a large receiver, and having a pressure of two pounds? 3d. What will be the shape of the expansion curve on an indicator diagram if air is used instead of steam? 4th. Would it pay a steam company to feed hot water if they have no exhaust or waste steam? 5th. If I place two gauges on a boiler, one at the top and one at the bottom of the boiler, will I have the same pressure? That is, will the pressures on both gauges be alike? If not, why?" *A.*—1st. Air acts the same as steam in this respect. Consult a table of steam pressures at two pounds pressure. 2d. One inch pipe will discharge about 46 cubic feet of air in one minute. 3d. The expansion curve should be the same with air as with steam. 4th. Yes, for the boiler's sake alone it would pay to feed hot water, even if had to be heated independently. 5th. The gauge on the bottom of boiler will show more than the one on top. This is due to the weight of water. It will show as much more as that height of water in the boiler will weigh.

(343.) G. W. D. asks: "What is the best way to set slide valves on a duplex pump without an indicator. Please make it plain and practical." *A.*—If you had told the make of the pump we could give you a better answer. But the following, carried out in a proper manner, will help you out: When one piston, it matters not which, is at the end of its stroke, adjust the valve of the other cylinder so that it will have the desired amount of lead for the opposite stroke. Do the same with the other cylinder and set the valve by its sister cylinder. If the valve opens more at one end than at the other, adjust it with the nuts on the valve stem until there is the same opening at each end of the stroke.

(344.) P. J., Cleveland, O., asks: "Please inform me through your 'Questions and Answers' column, whether carbon or wire is used in incandescent lamps, and if carbon is used, how it is made?" *A.*—To make wire for the incandescent loops in electric lamps a silk thread is covered with carbon, consisting of a paste. It is then baked, which incinerates or burns out the thread. It is then ready to be placed in the lamp. Wire is no longer used.

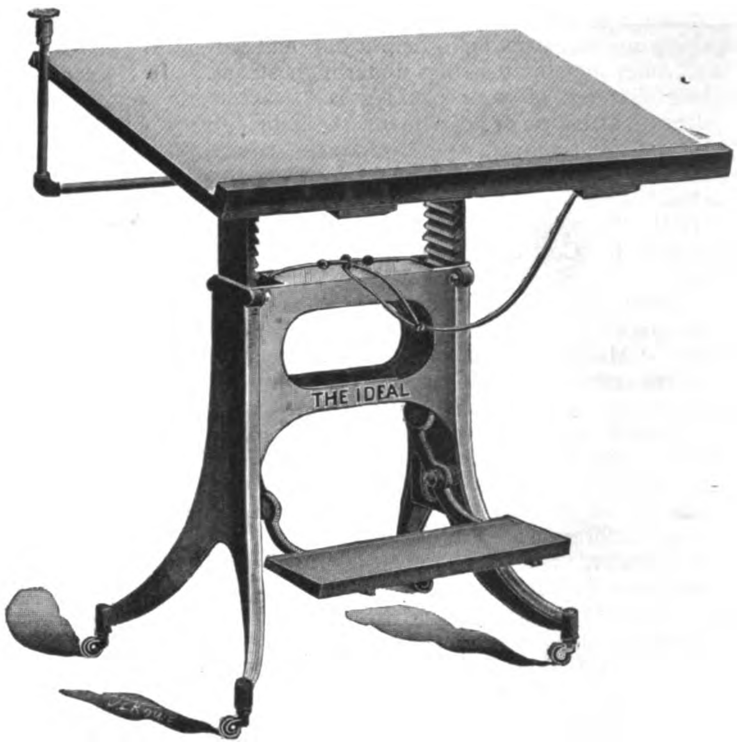
(345.) A. Ramstrom, McPherson, Kans., writes: "I am running a Corliss engine 12"x36" which is furnished steam from two boilers 54" diameter by 14 feet long, seventy 3" flues. The piston travel is 258 feet per minute. We burn the poorest kind of slack. In daytime the engine is pulling seven sets of double rollers, two flour packers, one bran packer, one large feed burr, and one large and several small grain elevators, also two large cleaners and separators, and we do not have very much trouble in keeping up steam, carrying 90 pounds. At night the engine only pulls the rollers alone, and we have the toughest time in the world to keep steam above 65 and 70 pounds. Where and what can the trouble be? Please answer in your next issue." *A.*—It would be impossible to tell what is the trouble with your plant without an examination. If we enumerate the things that *might* be the matter, it would fill several pages. We think that the engineer in charge should be able to discover and remedy the evil. If the day man can keep up 90 pounds in the day time, he surely should be able to do so at night. We suggest that he change off with the night man and use the plant just as he does during the day. He will, in this way way, we think, find the cause of the night man's failure. If he can not, you would do well to send for some other practical engineer. According to theory it should steam better at night than in the day time.

(346.) J. N., La Crosse, Kans., writes: 1. "We have made a small boiler by taking a piece of 6" pipe 30" long and put twelve holes on the circumference and ten such rows high, staggering them and tapped them out for ¾" pipe. The pipes are to be 6" long and closed at the outside end. This arrangement leaves a space of ⅝ longitudinal and of about ⅞ on circumference. What we wish to know is, will the 6" pipe be strong enough to carry 100 pounds of steam with safety? If it is not safe at 100 pounds steam, how much will it carry? 2. Would also like to know how the vacuum in incandescent electric lamps is produced." *A.*—1. If you had not drilled out so many holes your boiler would easily stand 100 pounds pressure. But you have them so near together, and have cut out so much of the sheet that it would not be advisable, we think, for you to carry more than 75 or 80 pounds. In cutting the threads, we would advise you to make them finer than those on the standard ¾" gas pipe, for by so doing you will get more threads and thus increase the strength. With the threads that a standard ¾" gas pipe would allow, there will be liability of blowing out the tubes, as there will be but 1½ threads to hold them. 2. The brasses are fitted in the neck of the bulb with the incandescent loop inside. On the apex of the globe is an open tube. Through this aperture the air is pumped from the lamp and the tube heated and closed by a blast. This leaves the bulb, with loop inside, a perfect vacuum and completely air tight.

(347.) J. V., Rochester, Ind., asks: "I would like you to inform me through your paper what has become of the firm called Steel & Stannard, Jersey City, N. J.? I have an engine lathe with their brand on it, and I want to have some repairs made. I have written to that city and got no reply. Perhaps you can inform me what has become of the firm." *A.*—We are not acquainted with the firm. If you received no reply from them, it would probably be well for you to get your repairs made at some machine shop in your vicinity.

THE IDEAL DRAWING TABLES.

We illustrate this week, the new drawing stand being placed on the market by W. S. Rogers, of Troy, N. Y. They are now being made in two sizes, the smaller size being furnished with a board 26" by 38", and the larger size having a board 36" by 48". Although these sizes of boards are furnished, the tables will support much larger ones. The boards are of clear pine and are shellaced black, if the purchaser desires, that they may also be used for sketching purposes. The frame work is all iron, made light and strong. The elevating standards are raised and lowered by means of the foot-rest (which is a thing to be desired on all drawing tables), which folds up out of the way when the board is at its lowest position. The board is held in its different positions by positive interlocking toothed dogs, thus giving the draughtsman a feeling of security when at work. Another good feature to be noted are the casters upon which it is mounted, making it easy to move about to get proper lights from windows. These tables are all bronzed a beautiful gold and fold up like a jack-knife when not in use, and make a nice easel for the house as well as table for the office.



THE Lodge & Davis Machine Tool Co.'s works, Cincinnati, O., have just closed a contract with the State College of Kentucky, at Lexington, to furnish an equipment of their improved machine tools for their new mechanical hall. This is the leading university of Kentucky, and they are now preparing in an elaborate manner for the instruction of pupils in machine designing and construction, as is demanded by the latest shop practice. Their wood working department is already in operation, and as soon as their iron working shops are fully under way they can offer students the best possible advantage for gaining a thorough mechanical knowledge, as all their machinery and appliances are of the latest and most improved design. There seems to be unusual activity amongst the technical schools as this company have furnished several of them within the past two months with equipments.

A STREET car, equipped with electromotive force stored in storage batteries, has been making successful trips through the streets of Cleveland. It has been brought out by the Ford & Washburn Electric Co. The car is twenty-six feet in length. The cells are distributed under the seats. When a trip is made they are removed and other cells newly charged placed in, the operation taking four minutes. The car runs smoothly, rapidly and satisfactorily. It has made a trip of twenty-six miles, with a good load, without changing the cells. It is arousing great enthusiasm.

WE call the attention of readers to the announcement, found in our advertising columns, of the newly revised edition of Rose's "Mechanical Drawing, Self Taught." Other works of this famous mechanical author are mentioned. The young, old or middle-aged man can make no better investment of money than purchasing some of Rose's books. They are standard. H. C. Baird & Co., 810 Walnut street, Philadelphia, Pa., are the publishers.

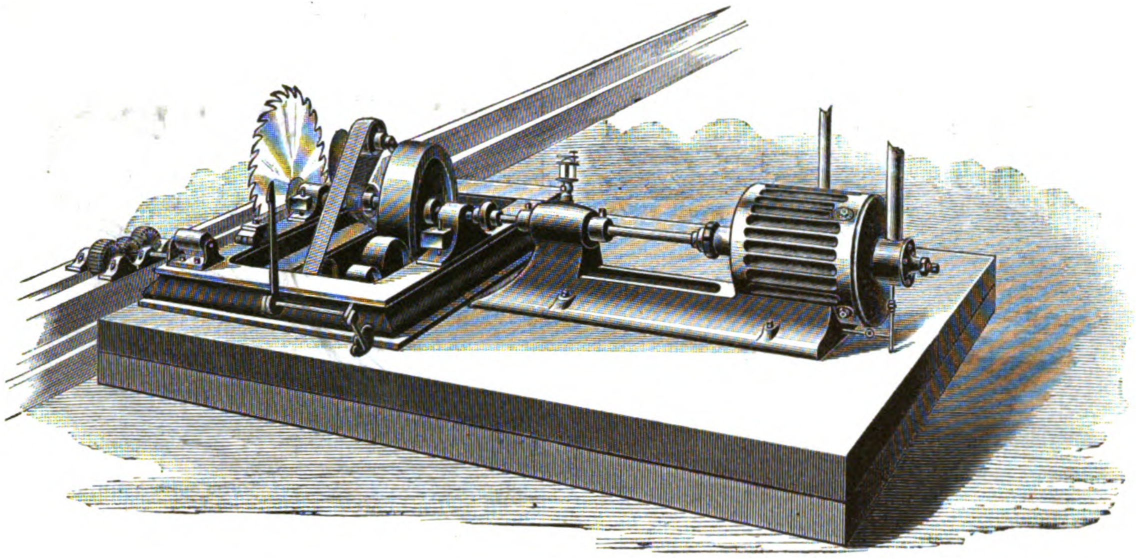
THE Lukenheimer Brass Manufacturing Co., of Cincinnati, O., have issued a calendar on which is represented, in raised, bronze print, a Lukenheimer gate valve, with a lever attached for opening and closing. The lever is movable. It is an ingenious and neat little calendar, which is more than can be said of most of the articles of that name.

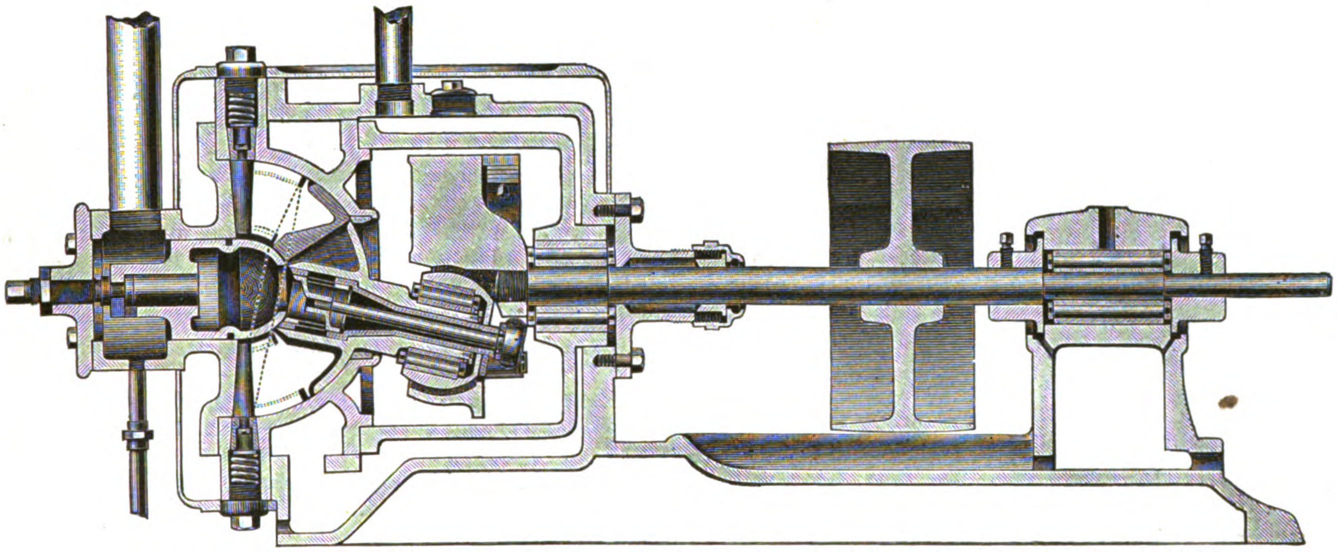
THE Energy Manufacturing Co., of 1115 S. 15th street, Philadelphia, Pa., have received several orders recently from England for their new improved center grinder.

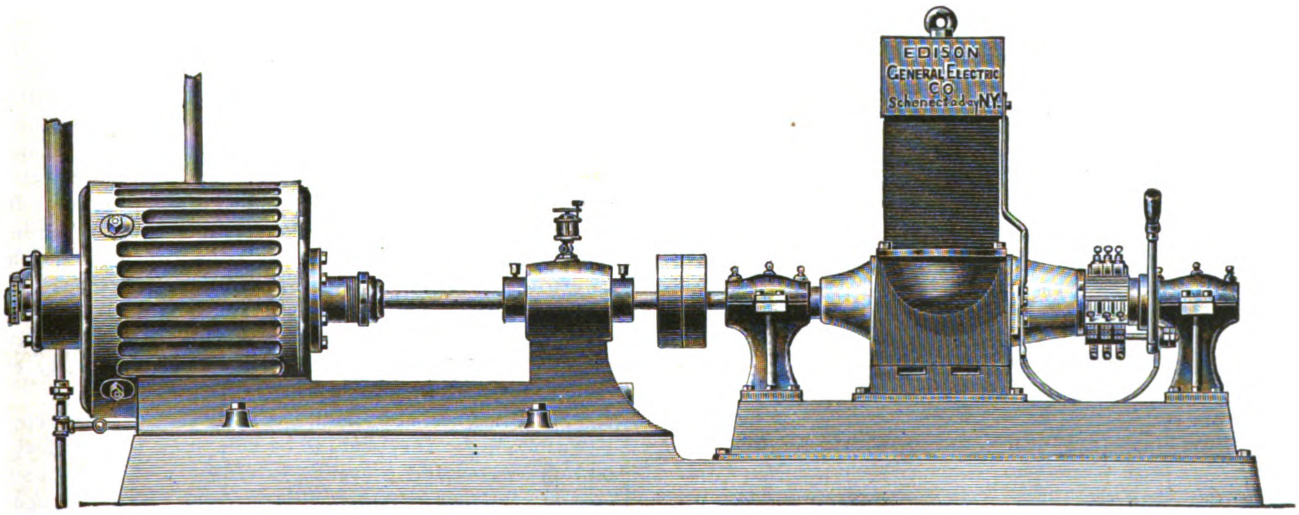
THE serial "A Set of Fine Tools," has again been held over, owing to the crowded condition of our columns.

AMERICAN HIGH SPEED ENGINE.

The engine illustrated in connection with this article works radical changes in the manner of applying steam in generating power. The inventor, Elmer Stillman Swift, sought a solution of the problem of greater speed, by stepping out of the beaten track, and the reception given his invention is good testimony to the success of his quest. His engine can be governed so as to run at any speed up to 1,000 revolutions a minute. It is not a rotary engine, yet its motions are such that there are no dead centers. It can be coupled directly to dynamos, circular saws, fans, blowers, threshing machine cylinders, fire-engine or other pumps. The piston or wabbling spherical segment, which corresponds to the piston in the ordinary engine, is perfectly balanced, so as to give no vibration, and the engine is therefore smooth-running and noiseless. It is light and compactly built, takes up little room and is with its governor wholly self-contained. Its direct coupling saves the cost of belts, extra shafts and counter-shafts, with their pulleys and bearings. It has only eight principal moving parts, with an automatic governor connected directly with the cut-off valve. All moving parts, with the exception of one bearing, are lubricated with steam, saving oil-cups and all danger from heating.


Manner of running Circular Saws, by Direct Coupling, with the American High Speed Engine.


A Longitudinal Sectional View, showing Interior Construction of the American High Speed Engine.



American High Speed Engine as Coupled Directly to an Edison Dynamo.

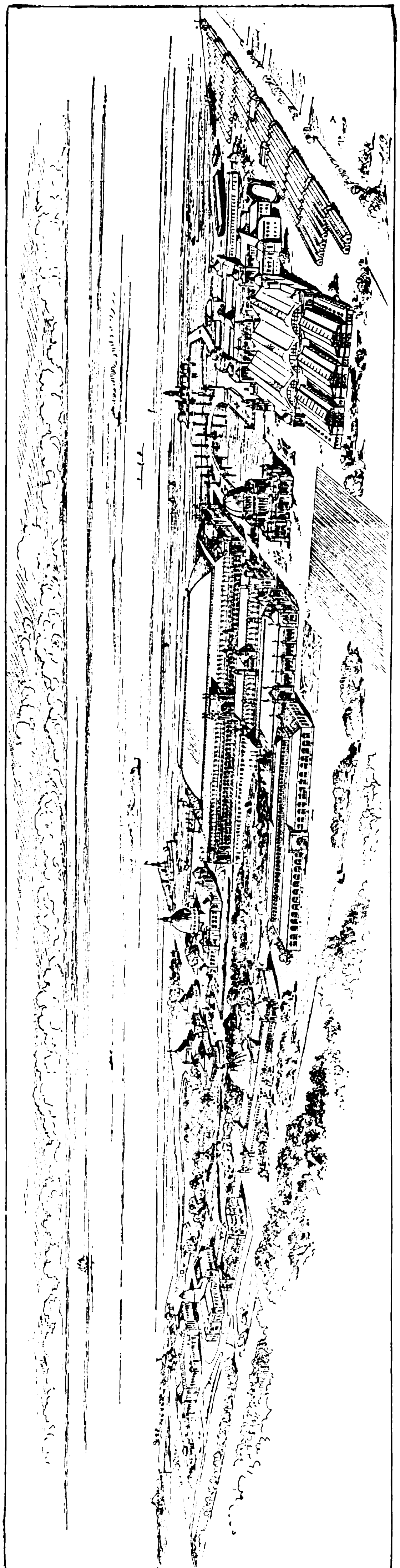
The American engine may be placed in any position, with base up, or down, or vertical, with either end up, as may be desirable, or necessary, to make direct connection with shafting or machinery. The cylinder is bolted to the bed, and projects into the steam chest which gives it a live steam-jacket. Radiation from the steam-chest, is prevented by a cast-iron jacket which surrounds it. The piston, which is a segment of a sphere fits into the cylinder which is concaved to receive it. The cylinder also has a circular opening through which projects a stem located centrally on the piston. This opening admits steam from the steam-chest to back of piston, and its area is so proportioned as to balance the pressure of steam in the compartments acting on the face of the piston. Thereby excessive friction between the piston and cylinder surfaces is prevented.

The partition blades and two similar blades, diametrically opposite, divide the space between the piston and cylinder head into four compartments. The follower-pin, the inner end of which is spherical shaped, fits into a cavity in the piston, and is for the purpose of furnishing a bearing to the piston. It is made hollow and connects the exhaust-chest in cylinder-head with the valve-chamber which passes centrally through the piston.

Of the two valves, the main one is located in the center of the piston and extends from the follower-pin, together with its stem, to the back of the crank-disk, and describes a circle with the piston-stem and crank-disk about the axis of the shaft, the radius of the circle decreasing towards the follower-pin. The cut-off valve is located inside the main valve, and controls the time of closing the steam port. Its stem extends through the main valve-stem to the back of the crank-disk, where it connects, by means of steel rods, directly with the governor weights, which have pivotal connection with the disk.

The cut-off valve-stem being connected with the governor-weights, as they move, they turn the valve and change the position of the cut-off segment in the main valve port, thereby varying the time of closing the ports in the piston as the valves revolve. The opening in the opposite side of the main valve,

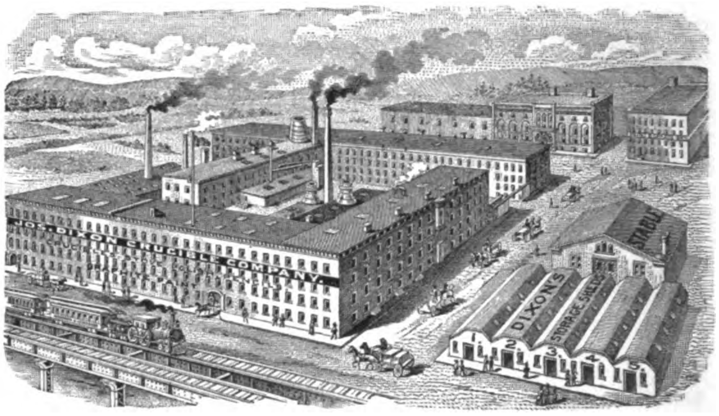
[Continued on page 12.]



WORLD'S COLUMBIAN EXPOSITION—BIRD'S-EYE VIEW—LOOKING EAST. CHICAGO, ILL., U. S. A., 1893

THE GRAPHITE INDUSTRY.

The graphite industry is fittingly represented by the company whose founder first gave it birth. The Joseph Dixon Crucible Co., Jersey City, N. J. was founded by Joseph Dixon in 1827, who, at that time, began the manufacture of black lead crucibles and completely revolutionized the crucible business. All crucibles used at the present day for melting brass, steel, copper, gold, silver, nickel, etc., are made of blacklead (the common name for graphite), and by the Dixon process. The Dixon Co. have not only been progressive, but they have been aggressive, and have pushed their goods into all parts of the civilized world. During the past year they made extensive changes in their factories, and we take pleasure in showing by the illustration herewith given the main works and offices located in Jersey City. Their graphite mines are at Ticonderoga, N. Y., and their cedar mills are at Crystal River, Fla. The nature of graphite, sometimes called plumbago, or blacklead, is not generally understood; and, therefore, its great value in the mechanical arts has not been fully appreciated. Graphite is one of the forms of carbon. It is not affected by heat, cold, acids, alkalies or any known chemical solvent. It is also the best solid lubricant known to science, a remarkable conductor of heat and electricity. The peculiar qualities of graphite have given it a wide range of usefulness. It is used in the manufacture of lubricants for all purposes, crucibles, stove polish, lead pencils, foundry facings, electrotyping graphite, graphite paint, etc. The Dixon Co. are miners as well as importers of graphite in all its forms, and use no graphite that they do not mine or prepare. Their mines are located in Ticonderoga, N. Y., and they have every facility in the way of chemists and expensive machinery, etc., necessary for completely freeing the graphite from the silica, sulphur and other impurities which it contains when it comes from the mines. The company's illustrated catalogue of graphite productions is an interesting pamphlet and well worth reading. It is sent free on application.



A COMPOUND TO AID COMBUSTION AND SAVE FUEL.

The Standard Coal Co., 244 Washington street, Boston, Mass., owns and operates a chemical compound for combining with coal, which has been found by test to possess many advantages. The claims made for it are briefly stated as follows: It promotes the combustion of the coal by re-enforcing the fires, producing a higher temperature, and generates more steam than when coal is burned in its natural state. It retards the gases and prevents the escape of smoke or free carbon and causes complete combustion. It increases the horse-power of boilers and prevents the formation of clinkers, and makes one-half less ashes, and effects an economy in the consumption of coal treated with these chemicals, from 15 to 30 per cent. The inferior or low grades of coal, such as culm, screenings, lignite, etc., when thus treated, will produce as much heat as higher grades of coal for boilers, locomotives, etc.

No alterations are required in the setting of the boilers for burning coal when thus treated. It will do away with nearly all smoke, cinders and gases that now escape from locomotives, smoke-stacks and chimneys. The cost, it is estimated, will not exceed one-fifth of the economy effected in the consumption of coal by the use of the compound. It will save the grate bars and displace blowers which are expensive to keep in running order as at present in use. There is nothing in the compound that is dangerous or explosive, nor deleterious to the iron in the boiler. The compound is particularly valuable for locomotives on railroads, ocean steamers and manufacturing industries, and on locomotives it will increase their carrying capacity and assist in hauling the trains over heavy grades.

H. L. Bowker, Massachusetts State assayer, thus reports the result of tests he has made: "It appears to be composed of chemical ingredients, that retain the gases and prevent the escape of free carbon or smoke, thereby increasing the heat obtained from the coal. Its action upon the grates, tubes, or surface of the iron exposed, is much more favorable than the coal burned in its natural state: the iron is cleaner and less liable to corrode. The tests made for the action of the chemically treated coal upon iron, were conducted in a large furnace at a high temperature, the iron carefully weighed and otherwise tested, with the results as before stated."

The main World's Fair buildings, exclusive of what will be necessary for their roofs and for their interior finishing, require 250,000 panes of glass and about 250 tons of paint. An expenditure of almost $500,000 is necessary for these items. The great Manufactures Building requires 50 tons of paint and 30,000 panes of glass of 26 different sizes, the average size being 27x44 inches. In the Transportation Building will be 112 circular sashes, 12 feet in diameter, each containing 37 lights; and 68 semicircular sashes, 22 feet in diameter, having 60 lights each.

HOW TO SAVE FUEL IN IRON MAKING.

At the Mason College, Birmingham, January 28, Mr. Thomas Turner, delivered the second of a course of six lectures on "cast iron." In giving a description of the production of cast iron in the blast furnace, the lecturer stated that the quantity of material used to produce one ton of pig iron was very much greater than the weight of iron produced. Thus, in the Middlesbrough district, about 63 cwt. of raw stone is needed to yield a ton of iron, the ironstone being calcined before it is put into the furnace, and thus becomes reduced in weight to about 48 cwt. In addition to this roasted iron ore about twelve cwt. of limestone is added to act as flux, while about a ton of best Durham coke is used as fuel. No less than 5 tons of atmospheric air is needed to burn this fuel, and the whole of this enormous quantity of air has to be heated to a red heat by powerful firebrick stoves on the regenerative principle. The product of the action of the blast furnace, in addition to the ton of iron, is about 1½ tons of slag and about 6½ tons of waste gases. These gases are now almost always utilized for raising steam and heating the blast for the furnace. Thus, in the chief iron-producing district of this country, it is necessary to introduce into the furnace 9 tons of various materials in order to obtain a ton of cast iron, and at the same time it is necessary to in some way dispose of 30 cwt. of slag, which is at present practically valueless. In districts where richer ores are used proportionally smaller weights of ore are needed; but the other materials are nearly constant in quantity. Hence it will be pretty evident that it is extremely unlikely that it will ever be possible to make iron at a much cheaper rate than ruled through the years of bad trade during the eighties. The blast furnace is by far the most economical apparatus we possess from a thermal point of view, though there are still possibilities of improvement even in this direction. In the earliest explanations of the action of the blast furnace it was supposed that the ore was reduced by the direct action of the fuel, in the same way as is the case with other metallic oxides. But more careful investigation showed the great importance of the action of the furnace gases, and it was recognized that in order to get complete reduction of the ore in a coke furnace it was necessary that the proportion of carbon dioxide in the waste gases should not exceed about twelve per cent. In order to obtain this composition it is necessary to employ about 19 cwt. of coke, and this quantity was for some time regarded as the lowest fuel consumption which could possibly be maintained for any lengthened period. But it is now recognized that this minimum is not the theoretical limit of economy, but only the limit under certain conditions of working. It has long been known that where charcoal is used as fuel in the blast furnace the gases may contain a larger proportion of carbon dioxide than is the case with coke furnaces: or, in other words, the furnace gases may be more fully oxidized, and more useful work can be obtained from the fuel. As a natural consequence the fuel consumption is lower in a charcoal than in a coke furnace. But it has also been noticed in America that coke furnaces have been worked in recent years with several hundredweights of coke per ton less than the minimum of 19 cwt. In this district also equally low fuel consumption has been obtained. This economy appears to be connected with the partial reduction of the iron by solid carbon itself, instead of by the furnace gases, especially with porous fuels such as charcoal or soft coke. The iron could be reduced and the metal and slag melted with about nine cwt. of carbon, and it is at present quite problematical how nearly this low limit will be approached.—[Colliery Guardian, London, Eng.

Chicago Pushing for a Technological Institute.

The movement in Chicago for the establishment of a technological institution, with physical laboratory and museum of mechanical arts, was given added impetus by way of sentiment-making, at the February meeting of the Chicago Electric Club. Hon. Francis W. Parker delivered the address of the evening and there was a discussion by well-known Chicagoans, including President Sunny, of the Electric Club, Ex-Mayor Roche, Director Revell, of the Columbian Exposition, Rev. Dr. P. S. Henson and Dr. Wm. R. Harper, President of the University of Chicago. Mr. Parker made these, among other points, as to Chicago's need of men trained in special engineering lines:

"In the address of the President of the American Society of Engineers, at Chattanooga, on the 22d of May, 1891, every one of the great engineering works enumerated as completed or actively agitated during the preceding year were of direct, immediate and paramount interest to Chicago, except the Croton aqueduct, while of seven great bridges mentioned, five were directly tributary to Chicago! It is easy to show our present interest in the engineering of both and and water, and in so doing we see at once by what means the present greatness of the city has been obtained, and also along what lines its future greatness will be reached. Five million freight cars are received and forwarded at Chicago, annually. This is the terminus for 55,000 miles of railway or nearly one-third of the total mileage of the United States; it is the chief objective point for 85,000 miles of railway or half the total of the United States; 13 000,000 tons of freight carried by 24,000 arriving and departing vessels, the same being one-third the total tonnage of the lakes and rivers of the United States, annually float in our harbor and canal; the vessels of the lake in whose business we have such tremendous interest are valued at nearly $70,000,000 and in respect to size they have gradually increased until now eleven vessels of over 3,000 tons, and one of 5,000 tons are in process of construction; in 1890, 40 per cent. more steam tonnage was built on the lakes han on the seaboard, while the average vessel on the great lakes is twice the size of the average vessel on the seaboard; in 1890, there was 57 per cent. more steam tonnage on the lakes, in the class between 1,000 and 2,500 tons, than on he entire seaboard; last year the total lake shipments were valued at more han $500,000,000. These facts and figures show our great interest in the engineering of transportation and commerce, and also show how we must be especially and peculiarly interested in every scheme for the improvement or development of the American water-ways."

President Harper said that the University stood ready to take up the work that was the special theme of the evening, if the interests represented in the Electric Club would help. A citizen's movement is already on foot to provide apparatus and buildings.

The Effect of Low Water in a Boiler.

Some months ago the Manchester (Eng.) Steam Users' Association made an exhaustive series of tests regarding the effect of low water on boilers while in use. The result of these experiments is pretty well known to most engineers, for a description of the tests have been published in nearly all the engineering journals. It will be remembered that although the tests were very severe, no explosion was produced which could be attributed directly to low water. The effect of low water in softening the plates is well known and in the case of poor iron the bulging which follows the overheating will result in a rupture, which when once started and backed up by the pressure of steam within the boiler will cause the sheets to tear in such directions as can not be calculated beforehand, as the course will sometimes be through such parts of the boiler as might be considered as being fully as strong as any other part. Crown sheet boilers usually suffer more from the effects of low water than do the other types, principally on account of the large area of flat surface which is overheated. The cry which is always raised of low water whenever a boiler explodes may be the expression of opinion of those making it, but it is seldom borne out by the facts. The principal causes of such explosions will generally be found among the following: poor material in the plates, imperfect construction of the boiler and initial strains set up in the plates by the use of the drift pin; corrosion of plates through want of proper care and attention, producing weakness and inability to resist internal pressure; over pressure of steam; the sudden closing of a valve through which a large volume of steam is escaping, such action producing a hammer-like blow. In the experiments cited, it was found that the introduction of cold water into a boiler that had become red hot from lowering the water level produced no disastrous effects further than straining the seams and rivets and buckling or flattening the crown sheets, and in no case was the boiler burst or the setting disturbed.—[Stationary Engineer.

Popularizing Air as a Carrier.

Owing to the increase in the number of air brakes used most railway shops find it necessary to have their plants supplied with air pumps, with pipes leading to all important parts of the shops to be used in testing. Another way in which this air pressure can be used to great advantage is in the sending of small, light articles from point to point. The transfer of mail and messages from one office to another, particularly when they are located in the different stories of a building, is often a great cause of annoyance. The average messenger boy is not a very reliable person and is often not at hand when his services are desired the most, which fact sometimes causes a delay in the delivery of important messages. It is probably questionable whether it would pay to establish an expensive system for this purpose, but there are great many places about large plants where a short and straight line could be established. A very successful and convenient arrangement of this kind has been put in operation in at least one of our large railway shops. The tubes are of heavy, galvanized iron made by an ordinary tin smith, and consequently the expense is not great. The carrier is made of the same material, with a piece of leather fastened on one end forming a packing, and in the other end is driven a wooden plug to act as a guide and receive the shocks caused by the stopping of the carrier at the end of its journey. A very small amount of air is consumed in the transfer of a message, and instead of waiting for a messenger boy the messages can be delivered in a few seconds from either end of the line at any time. Two or three such tubes as this in a large plant might easily save the expense and annoyance of a messenger boy and prove a great convenience.—[Railway Review.

Big Steel Trusses for the Manufactures Building at Chicago.

The contractors who are putting up the big steel trusses for the roof of the Manufactures building are getting ready for the biggest "barn-raising" in history There are 27 main trusses, with a span of 380 feet and a height of 211 feet. They are 14 feet wide at the floor and ten at the apex. These trusses with the eight smaller gable trusses weigh 10,800,000 pounds. The main trusses weigh about 350,000 pounds esch, and they are to be raised in position from the floor. To handle these great iron structures a "traveler" is being constructed on the floor of the building, 50 feet by 260 feet and 120 feet high. On top of this "traveler" will be raised a central tower 135 feet high, so that the total height of this great lifting arrangement is 255 feet. It will weigh 720,000 pounds, and over half a million feet of lumber will be used in its construction. The floor of the building will not, of course, bear this great weight and the "traveler" will move on a track specially prepared for it. As much as is necessary of the floor will be torn up and three rows of piles will be driven to support the "traveler." When the work of raising the trusses is finished, this piling will be sawed off and the floor relaid. Another big "traveler" is being rigged on the floor of machinery hall to erect the iron work in that structure—a task scarcely less difficult.

The Economy of Compound Engines.

Mr. Cooke, in his paper in the *English Illustrated Magazine*, calculates that the London & Northwestern engines collectively consume 3,095 tons of coal per day. Seeing that compound engines have been proved in actual working to consume about six pounds of coal per mile less than other engines on the same work, and that they are daily taking loads without assistance which any other type of engine would require two engines to work, it is evident that their adoption has been of material advantage to the company.

THE total amount paid out up to February 1st, by Treasurer Seeberger for the construction and other expenses of the Chicago Exposition, was $3,572,891.

AMERICAN HIGH SPEED ENGINE.

[Continued from page 9.]

which covers and uncovers the ports in piston on the exhaust side, remain open constantly, so that the exhaust is invariable. From the steam-chest it passes through the holes in the piston-stem to the inside of the cut-off valve; thence through a passage in the piston to one of the steam-chambers or compartments, between the piston and cylinder-head where it forces the piston away from cylinder-head. The stem of the piston isprevented from moving in a direct line with the action of the steam, by itsconnection to the crank-disk, and is compelled to describe a circle with theaxis of the shaft for its center.

Steam continues to flow into this compartment until communication is cut off by the cut-off valve; after which it continues to force the piston away from the cylinder-head by expansion, until the stroke is completed; or, in other words, until the face of the piston has reached the limit of movement away from cylinder-head allowed by the piston-stem, as it is guided in a circle around the axis of the shaft. The port through which steam has been admitted to this compartment is now put into communication, by the main valve, with the exhaust passage through the follower-pin and passes out. In the manner described, steam is admitted to one compartment, or steam-chamber, after another, completing the revolution of the shaft; the time of closing the port for admission of steam being controlled by the governor, automatically, so as to maintain a uniform speed under varying loads and varying steam pressure. The main valve also opens communication with one compartment, or steam-chamber, after another and controls the admission and exhaust, which remain constant or invariable.

The more sensitive the action of an engine's governor the more even the speed and the more regular the amount of work accomplished. In the American high speed engine, the governor has control of the valve almost constantly and 4,000 shifts are made in one minute enabling it to meet promptly all conditions of varying load or steam pressure. The most serious obstacle to economy of fuel—the condensation of steam on the internal surfaces of the cylinder—is met in this engine by the high rate of speed it attains. The inventor lays down the proposition that the higher the speed, the less the condensation, and explains that the increased economy of the compound over the simple engine is due to the saving in cylinder condensation. He claims less condensation than is the case with slower working engines and that the necessity for compounding is correspondingly reduced. The American high speed engine is manufactured by the American Engine Co., Bound Brook, N. J.

A SMOKELESS FURNACE.

An invention designed to prevent the production of smoke in furnaces for steam boilers and secure increased efficiency, along with durability and cheapness of construction, is that of John Mitchell, of Rochester, N. Y.

In the accompanying drawings, representing this steam boiler furnace Fig. 1 is an elevation, the front of the furnace being removed. Fig. 2 is a transverse section on the line 2 2, Fig. 3. Fig. 3 is a plan. A is the boiler; B, the front grate, on which the coal is partly burned or coked; C, the rear grate, on which the combustion is completed; D, the bridge-wall, and E E′, the descending-flues, through which the volatile or gaseous products of the combustion on the front gate are conveyed underneath the rear grate, so as to secure their complete combustion by passing upward through the incandescent material thereon.

The grates are placed on the same horizontal level, or so that the combustible can be transferred from the front to the rear grate, and an opening F is formed in the bridge-wall immediately above the grates through which the coked or partly burned coal is transferred from the front to the rear grate.

Fig 2

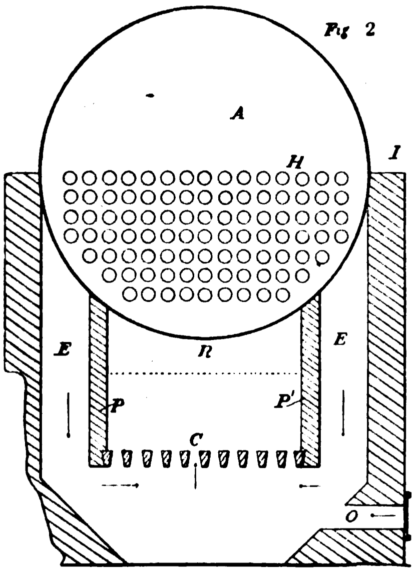
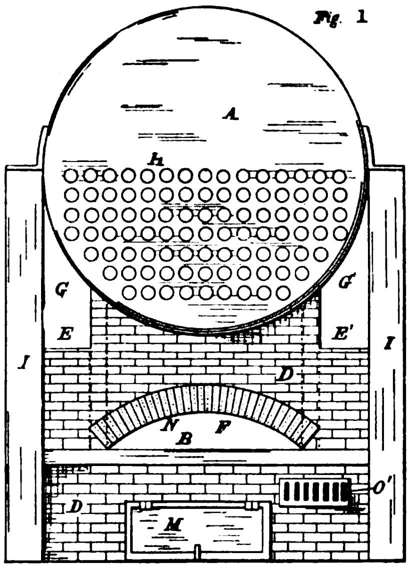


Fig. 1

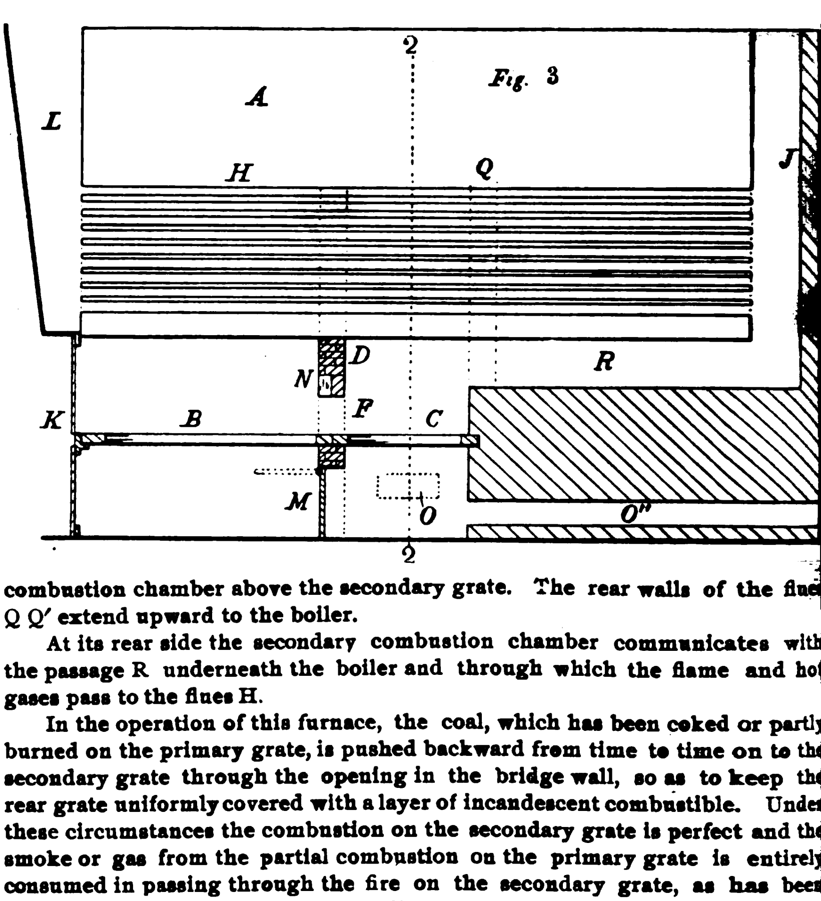


In practical use the coal is kept piled up on the front grate, so as to close or partly close the opening F, thereby compelling the gases and volatile matters to pass into the flues E E′ through openings G G′ in the bridge-wall. Provision is made for admitting air underneath the rear or secondary grate through a suitable draft-opening provided with a damper. The boiler is of any ordinary type provided with the return flues H. The side walls I I of the boiler setting are constructed in any ordinary way of dimensions suitable to the size of the boiler, and the rear wall J is placed at such a distance from the rear end of the boiler as to permit the products of combustion to pass upward and enter the flues H. K is the front of the boiler, provided with the usual doors, and L the uptake.

The bridge-wall is provided below the grates with a door M, through which the ashes are removed from underneath the secondary grate. The opening F in the bridge-wall above the grate is preferably made in the form of an arch, constructed of any suitable fire-brick N, which are set in two rows with broken joints, as indicated by the full and dotted lines in Fig. 1, so that in case one or more of the bricks in one row should be broken or crack off, the arch will still be preserved by the bricks of the other row, so that there is no gap or opening through which air or gases can obtain access directly to the combustion space above the secondary grate without passing through the flues E E′. Above the arch the bridge wall is continued all the way up to the lower side of the boiler or other surface which it is designed to heat, except that the openings G G′ are formed in the wall, through which the gaseous products of the primary combustion obtain access from above the front grate to the descending flues E E′, which open into the space underneath the secondary grate. Air is admitted under the secondary grate through a suitable passage provided with a regulating valve or damper. This passage for a single boiler is arranged at one side, as indicated at O, Fig. 2, or for a battery of boilers may be placed in the bridge wall below the grates, as shown at O′, Fig. 1, or may enter from the rear, as at O″, Fig. 3.

The flues E E′ are built of brick or in any other suitable way, being closed on all sides, except as they are provided with the openings G G′, and are open at their lower ends into the space below the secondary grate. At the inner sides the flues are formed by the walls P P′, which separate the flues from the combustion chamber above the secondary grate. The rear walls of the flues Q Q′ extend upward to the boiler.

Fig. 3



At its rear side the secondary combustion chamber communicates with the passage R underneath the boiler and through which the flame and hot gases pass to the flues H.

In the operation of this furnace, the coal, which has been coked or partly burned on the primary grate, is pushed backward from time to time on to the secondary grate through the opening in the bridge wall, so as to keep the rear grate uniformly covered with a layer of incandescent combustible. Under these circumstances the combustion on the secondary grate is perfect and the smoke or gas from the partial combustion on the primary grate is entirely consumed in passing through the fire on the secondary grate, as has been demonstrated by practical use extending over a considerable period of time.

Coking chambers, arranged at the side of a grate and of the combustion chamber and provided with a conduit for gases, extending across the front of and above said grate, were known prior to Mr. Mitchell's invention. In such construction the coke could be poked out onto the grate. The inner wall of the coking chamber was liable to be speedily burned out. By the construction herewith illustrated, the coking chamber is placed in front and the grate C directly behind it, the interposed bridge wall being provided with suitable opening, being so related to the two grates that the coke can be pushed through the front door directly back onto the rear grate; and, further, the gases from the coking coal are, together with air for combustion, delivered directly under the rear grate and at both sides thereof, thus more thoroughly distributing them and avoiding also the obstruction of the front of the grate by the conduit above referred to.

The patent is assigned by Mr. Mitchell to Clark's Coking & Smokel
Furnace Co., of Rochester.

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Numerous letters of inquiry for information relative to rates and routes to the West, received at the General Ticket Office of the New York, Chicago & St. Louis Railroad, in Cleveland, O., indicates an increasing desire to seek homes in some of the new States recently admitted into the Union. With fully matured State governments, those of our people who contemplate a future home in the Great West, feel a greater confidence in investing than was felt under their uncertain futures as territorial governments.

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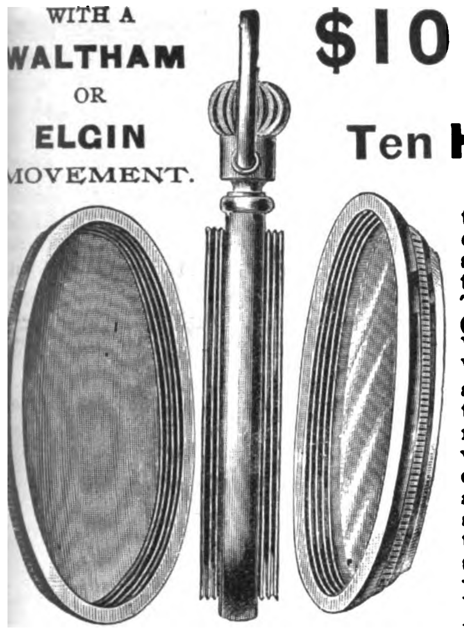

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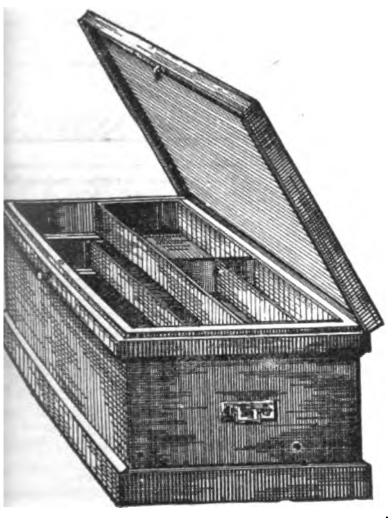

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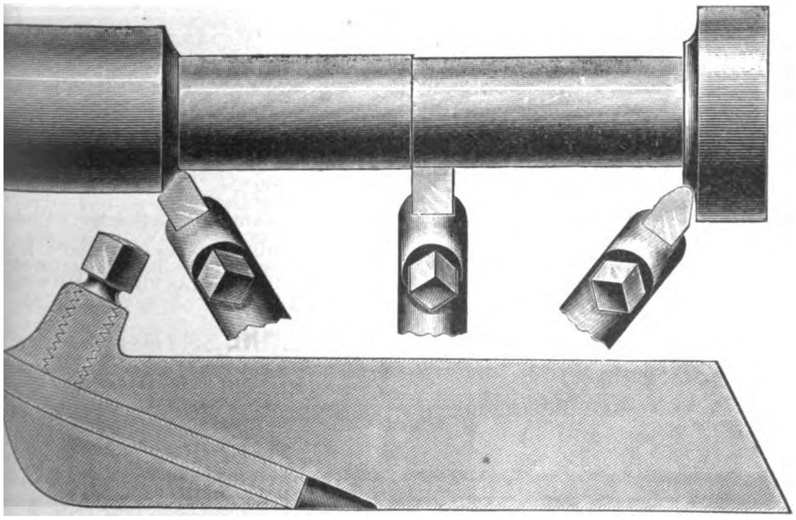

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WORK on the great bridge over the Mississippi river, at Memphis, Tenn., is progressing rapidly. All the spans are completed with the exception of 500 feet on the Tennessee side. It is stated that the bridge will be open for traffic May 1. The total cost will approach $3 000,000.

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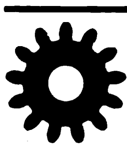

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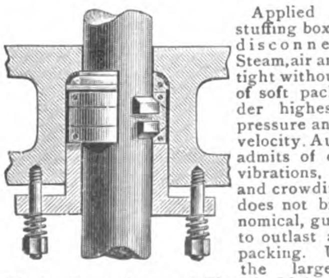

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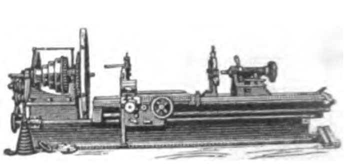

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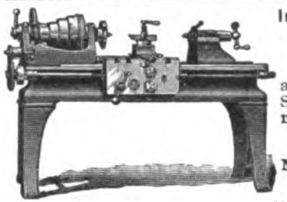

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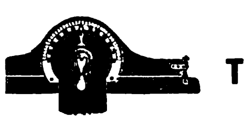

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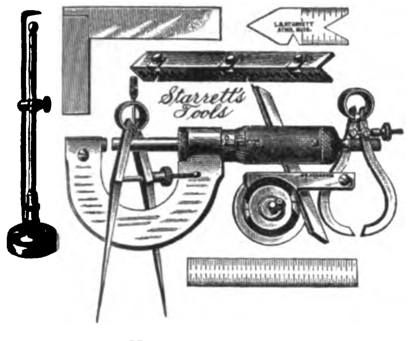

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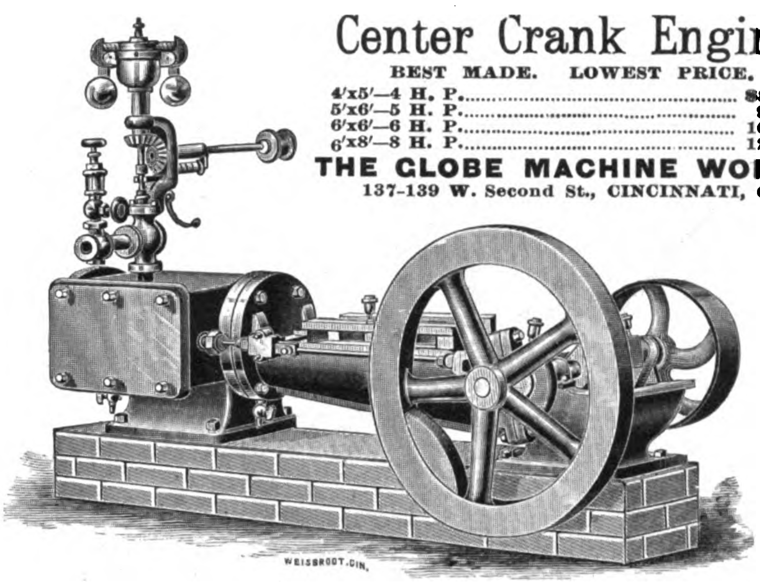
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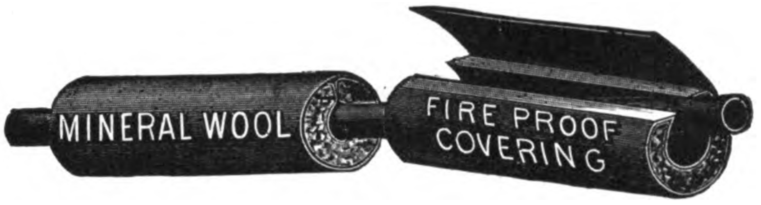

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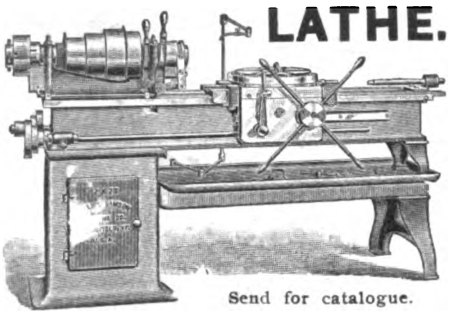

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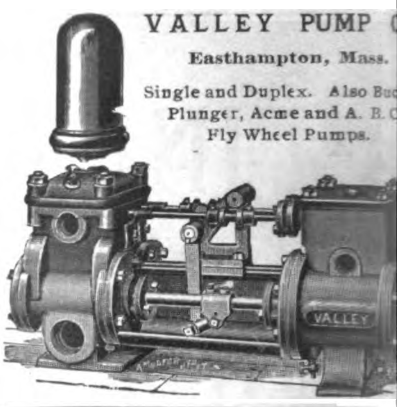

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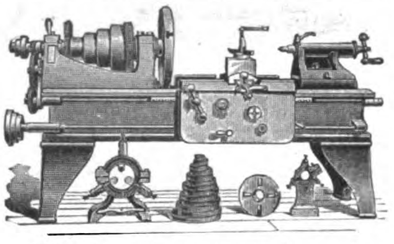

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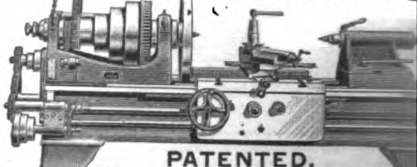

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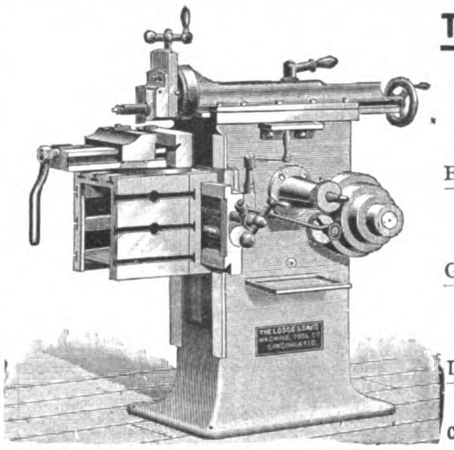
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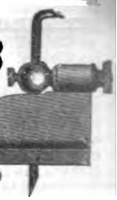

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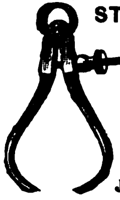

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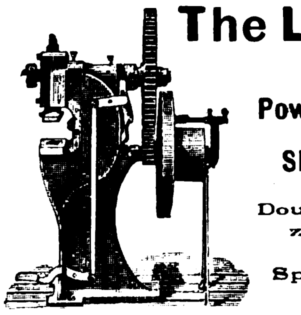

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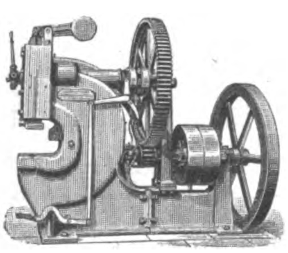

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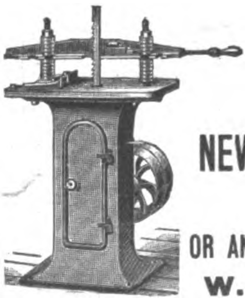

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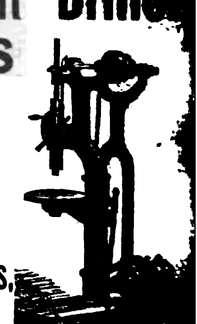

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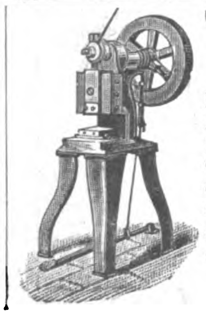

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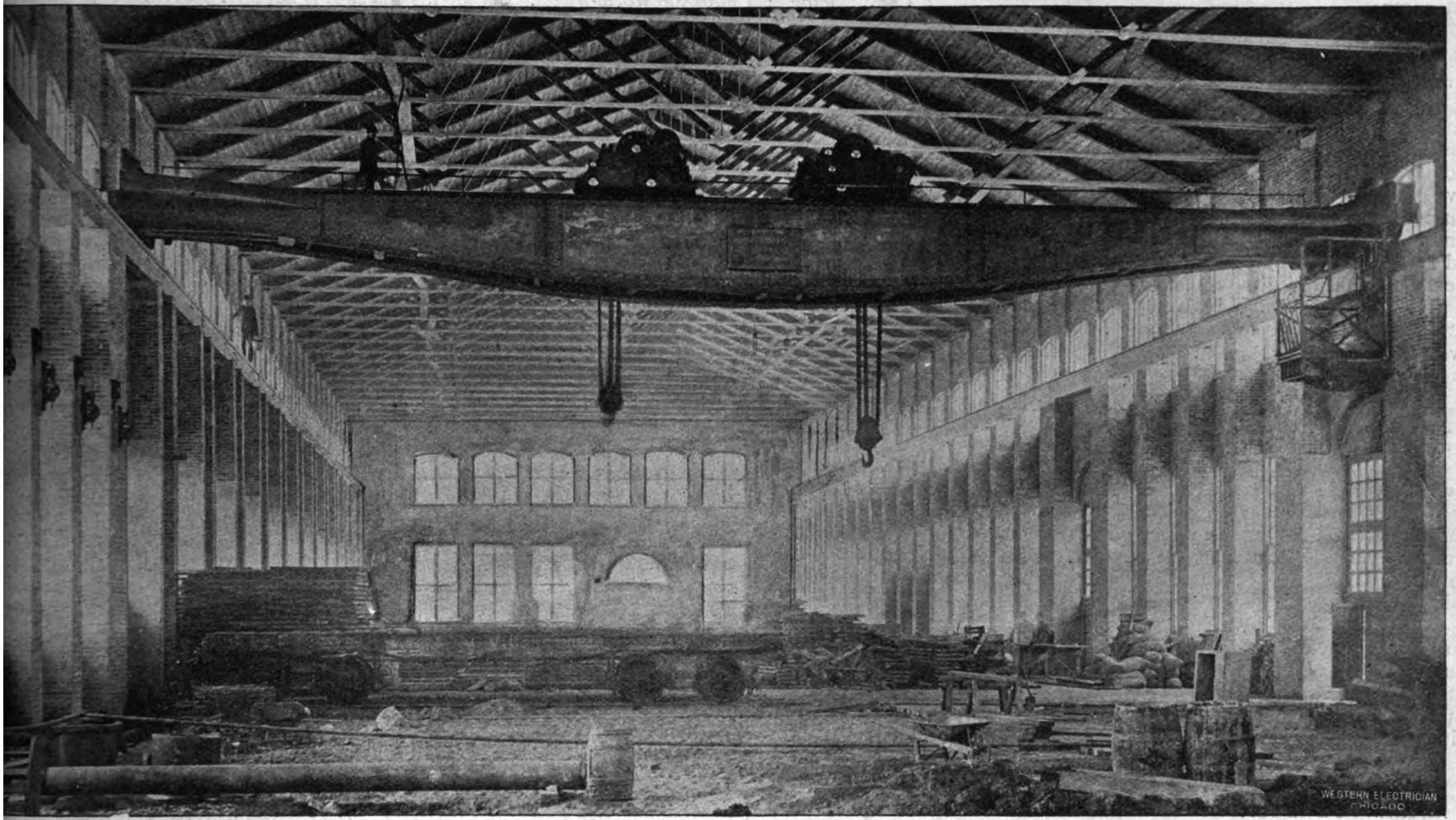


FIG. 1.

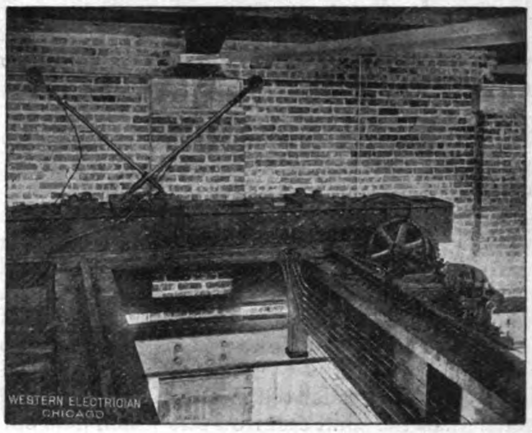
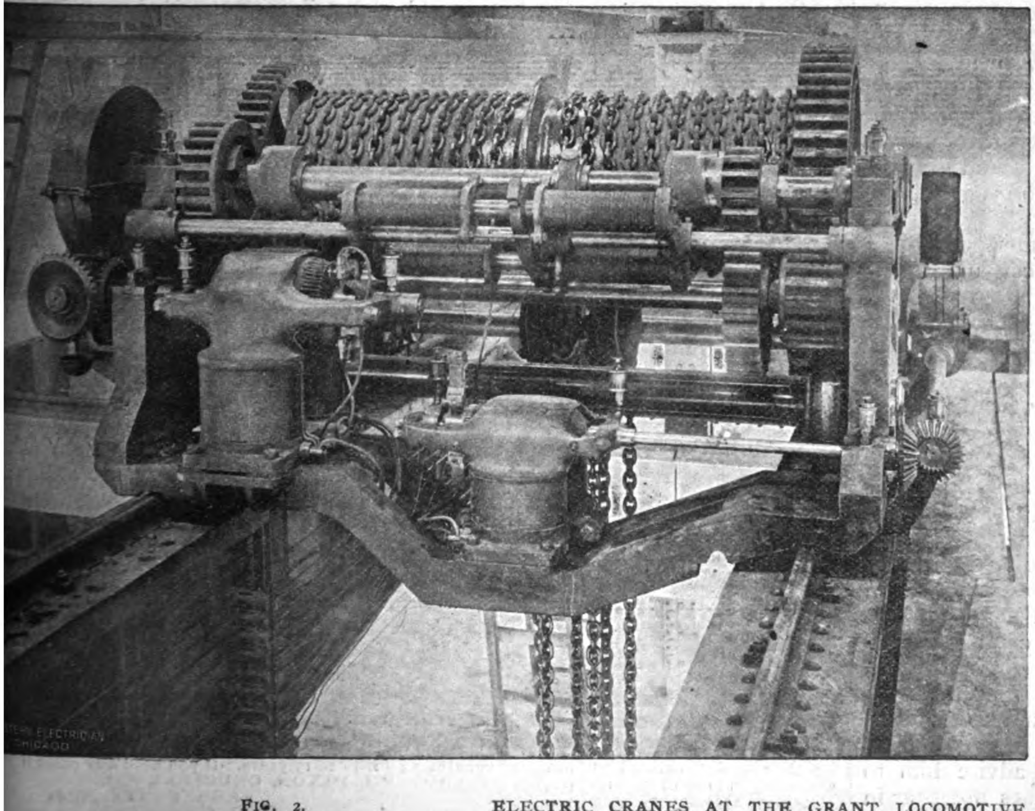


FIG. 3



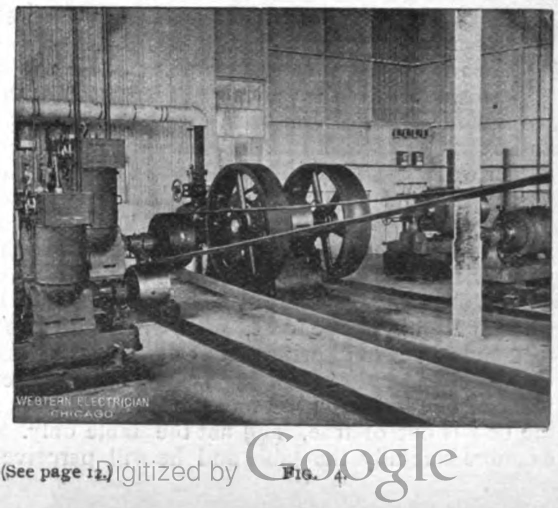


FIG. 2. ELECTRIC CRANES AT THE GRANT LOCOMOTIVE WORKS.—(See page 12.) FIG. 4.

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More About Cutting Speeds.

EDITOR SCIENTIFIC MACHINIST:

In reply to an article by J. J. Sand under the heading, "More about cutting speeds," published some time ago, I will say I was deeply interested with the subject and set my wits to work to overcome the trouble, or in other words, to run a lathe at more than eight speeds, and as a result I have got a little model that gives 16 perfect speeds, without the use of friction pulley, except the two now in use on all lathes, or gears, the secret lying in the cone pulley on the counter. This is not an expansion pulley, and I use the same length of belt to get the 16 speeds. It is operated by a lever, is very simple to understand, is reliable and durable.

Now, perhaps Mr. J. J. Sand will suggest a way in which a man without means, living out in the country, can get any benefit from such an invention. I would be pleased to hear from Mr. J. J. Sand, and will watch his answer with interest.

J. E. SMITH.

A Device for the Engine Room.

EDITOR SCIENTIFIC MACHINIST:

I send herewith the sketch of a little contrivance, that is very handy to use on certain engines. [It consists of a piece of wood from two to three inches thick and as long as may be necessary, beveled about half its thickness at each end on the upper side. No sketch is necessary to understand it.—ED.] It can be made of walnut or any hard wood with a common round-headed screw at each end and a longer screw in the center, which can be screwed up or down to suit the occasion. It is used to adjust the piston rod so as to cause it to run parallel to the guides, and can be used only on engines with wrought-iron frame, or the old-fashioned box frame with guides bolted to the frame. It is so simple that no explanation of how to use it is needed. The one the writer first used was a strip of pine split off from a pine board with a coal hammer, with three wire nails driven through it.

W. S.

Welding Boiler Tubes—A Question for Readers.

EDITOR SCIENTIFIC MACHINIST:

Some time ago some one inquired how to weld boiler tubes in a common blacksmith's forge. Here is a very good way in which that can be done:

Enlarge one end of the shortest piece, and one end of the long piece make smaller, then telescope the two about ¾ of an inch. Now, get an iron shaft as large as will go into the tube and lay across the forge with the tube slipped over it. Block the shaft up so that the tube will hang down from the top of the shaft. By such an arrangement the inside of the tube will be smooth for a scraper, while if there was no shaft used the inside would be rough and a scraper could not be used to advantage.

When the tube gets to a welding heat strike on the *end* of the short piece first, with a heavy hammer, then with a light and broad-faced hammer make the weld. Borax can be used to good advantage, but it is not necessary. The next thing is to test the tube, which can be done in the following manner: Drive a plug in one end of the tube, stand it up on that end, and fill it up with water. If it does not leak the job is well done, and if it does, weld it over again.

Will some reader tell me how to make a good pipe center, something better than the solid cast iron one which gets cut up after being used a few times?

A. J. KNIAVA.

Planer Tables High in the Middle.

EDITOR SCIENTIFIC MACHINIST:

In answer to "Reader," Cincinnati, O., I have to say as follows:

It is not likely that a new planer is in such condition, nor that an "out-of-the-level" is the cause of it, but rather the continual use of it and overstraining. In former times there were no such things known as planer chucks. The table was always used in that place. The work was placed between two posts resting in slot-holes in the table, and keyed between them to give the necessary resistance for the tool to hold the work firm. This continual strain on the table causes the table to stretch on the upper side and get high in the middle. Any planer run in such condition will by degrees wear out the extreme end of the bed, especially on short work. If this is the case, such a machine could not be restored to its mechanical accuracy without having another planer to true it up with.

The planer described by your Cincinnati reader should do accurate work of five feet in length and under. If it does not, then it proves that the bed is out of true, and not the table only. I would advise him to examine carefully the table and he will perceive that it does not bear in the middle of its length, but only at the ends. The way to remedy the evil would be to have the sliding grooves planed over in another machine. If this could not be done, there is another way of getting it done, though not so recommendable. Take the bed off, and pin the table on the lower side, so as to stretch the iron enough to make it bear again in the middle of the bed. Thus you counterbalance the strain of the table, which by degrees it received, perhaps unknown to its operators.

MILLER.

More About the Perfect Worm and Wheel.

EDITOR SCIENTIFIC MACHINIST:

I note with pleasure the remarks of Frank Lynn regarding the scheme of making screw-drivers, described in my article in the issue of January 1st; also Mr. Lynn's questions and doubts about the worm and worm-wheel mentioned in the same article. Regarding the latter print I would say, both the questions and doubts arise from the incompleteness of my description, which I will supplement here by stating that the hob as well as the worm must be produced by a hob. The principal difficulty experienced in producing a perfect worm and worm-wheel is making the hob, which hobs the worm-wheel. In the first place it is necessary to make a wheel with steel cutters arranged in the place of teeth, then to provide a means for revolving the worm blank and wheel hob together, giving each its proper speed, also means for feeding the two pieces together, as the hob cuts the blank. It is not necessary to have a full wheel for a hob—a single sweeping cutter properly revolved would answer the same purpose. It could be made in less time, but would not work as fast as a segment of a number of teeth or a full wheel. After this hob is obtained for hobbing the wheels it is a simple matter, from it, to make a hob for hobbing the worms. I would mention further that the worm blanks must be turned smaller in the middle than at each end, so that it will fit a circle of the diameter of the wheel at the bottom of the tooth.

Regarding the advantage of this wheel and worm over the ordinary, in which the worm is cut the same as a screw, I think that this point will be quite apparent now that I have more fully described the matter.

The elevator builder referred to in the article mentioned has special machinery for this purpose, which I believe would be shown to any one interested enough to call. Morse, Williams & Co., at Philadelphia, is the concern mentioned. This reference is made without their knowledge and I am in no way interested in the concern. It was through the courtesy of Mr. Stevens, the Superintendent, that this matter was brought to notice when I called there in a business capacity. No privacy was indicated by word, or appearance of the building in which the machinery is working, and I felt at liberty to give this matter to the readers of this paper the same as I hope to do with other points of the kind which I find in my travels.

J. J. SAND.

IN AND ABOUT THE SHOP.

My friend what are you hammering and pounding on that milling machine arbor and cutter for? Trying to get the cutter off? Do they always come off that hard and is that the usual way you have for getting them off? No? The feather got sheared off when the cutters got caught in the work on that last job, and as the cutter turned round on the arbor it wedged in and the "darned thing is tighter than Billy-be-Danged." And the foreman told you to get it off anyway, and the best way you could, did he? Well, "anyway" covers a multitude of sins, and you are not fully to blame for the method you are employing to get it off.

Now, let us reason together for a minute and see if we can't get that cutter off in some easier way. Suppose you were to go out in the blacksmith shop and get a short bar of inch square iron, point one end of it and heat it red hot, bring it in here and hold it against the side of the cutter about half way between the hub and the flutes, or teeth, letting the spindle rotate at the same time, what would be the result? You don't know? Well, don't you think that cutter would come off easy after about one dose of that kind of medicine? Still you don't know sure, you never saw it tried. Neither did I, for that matter, but knowing how metals will act under certain conditions, don't it look reasonable to you that something would happen? Oh, it does, a little bit? All right, let us try it. You get the hot iron, start up the machine and hold on the iron. I will hold my breath while we find out a thing or two. Now let her go and see wha— Oh, its loose is it? Comes off easy, too. Now why do you suppose it acted so? Expansion did it. Certainly. You lost one hour of the firm's time trying to bang and batter off that cutter without using your brains, when the use of said mixture of intelligence would have solved the difficulty in two minutes and not have put you out of sorts with the machine, the shop and the whole human race in general. Keep your brains circulating, don't let them clog up but keep thinking and reasoning out the why and the how of mechanics.

By the way, how fast does your machine table travel per minute? Don't know? Suppose I bring you a strip of iron 17" long and 2" wide and ask how quick you can mill it for me, what would you say? You would guess at it? Well, I suppose that about 99 out of every 100 of the men and boys who are running milling machines to-day throughout the country would do the same thing, too, so I can't scold on your individual account, but don't you think it would show more intelligence on the part of the operator of a machine if he could be able to answer all questions

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regarding the speeds, cuts and maximum limits of endurance it was capable of? And don't you think it would make him feel more interested in his business if he knew all this stuff? Now, Henry, just you try it and see if it does not work to your advantage, and in the end benefit you.

Hello, young man. Who are you that you should be asking Henry if he milled those chuck jaws you ordered yesterday? You are the time clerk, eh? Well, suffering, shivering Cæsar! but this beats anything I ever heard of. Is there anybody else coming round to give orders and instructions to the man in this plant? Where do you get authority to give orders and play "boss" over these mechanics? Always did it, haven't time to run around and hunt up the foreman to tell him what you want done. That is pretty good. I wonder what in Sam Hill the firm keeps all these foremen loafing around the place for when one or two real smart time clerks could look after things just as well.

Now listen, young man, I want to talk to you right here before all these men. It may rupture your spine of self-conceit, but I can't help it. The quicker we tap out a hole the quicker we get the set screw in, and if there are any more young men in the office of your calibre they had better come out at once and get reserved seats for the lecture. Don't you ever come out in this shop and give a single order (or a pair of them either for that matter) to any man while I am in control. Speaking for myself, I would no more think of giving these men orders changing the programme of work laid out for them by the foremen without consulting them first and having a clear understanding, than I would of forging the secretary's John Hancock to a bank check. It destroys all discipline, and as soon as the foreman allows you or any one else to step in between him and his subordinates, their respect for his position ceases, and he becomes lower in the social scale of the shop than yourself. Any one of the foremen finding you or any one else meddling with the work, or giving orders contrary or without his knowledge is perfectly justified in taking the offending party and pitching him out the window into the river. Hear me? In a shop where everybody is boss there is no boss, and where there is no boss there is no one to assume responsibility, and if no one is responsible the work is always half done and is never finished on time. Consequently, it is always done at a loss in instead of at a profit. We are going to run this shop at a profit, and have due respect given to each and every man about the place, according to his position and his ability to do the work in his sphere of usefulness, even if it takes a new time clerk to begin with. Now you may go to the office and hunt up the moral to be found in the happenings of the last fifteen minutes.

No wonder the men in this shop always say they "don't know" in answer to every question I put to them. Undoubtedly they have fared better by professing ignorance under the past regime than they would otherwise. Well, we will have discipline first, and in big allopathic doses, too.

THE OLD MAN.

THE MACHINIST OF THE FUTURE.

BY J. J. SAND.

One of the topics of great interest to every machinist to-day is, what kind of a trade will the machinist trade of the future be? In the last 20 years the cold chisel has been laid away and the file is used less every day for finishing. The cold chisel is still used, but not one-hundredth part as much as 20 years ago.

There is an engine builder in the southern part of Pennsylvania that builds an agricultural engine, in which the crank shaft and nearly all of the work is finished by grinding. Think of it, grinding the bearing pins and pistons of an agricultural engine! This is not done because the farmer will appreciate the difference between this finish and the file finish, but because of the greater economy. It is actually cheaper to produce these parts thus than by the old method, which is still in use by many builders of engines. I do not think it would pay for a small repair shop to put in a grinder for this purpose, just because an engine is built occasionally, but I know it would pay any concern that builds only a few sizes of engines and makes that their business, to put in such a labor-saving tool that not only reduces the cost, but improves the quality and accuracy of the finish.

No bearing can be made perfect except by using the best means within our power and then allowing the bearing to fit itself in running. The best machinist must use great care and plenty of time to file a shaft perfectly. In fact, the point is conceded that the less it is filed, the better.

In looking at the changes that have taken place within the last few years it seems to me that it is a matter of greatest importance to every machinist who expects to work at the trade 10 years hence to have an eye on the new ways of working that are constantly coming in. What value is a good old-fashioned sailor on the modern ship or gun boat? Of what value is a machinist who is capable of chipping and filing a cross-head pin or lathe bed in the modern shop? There is only a limited demand for each of these men who once were masters.

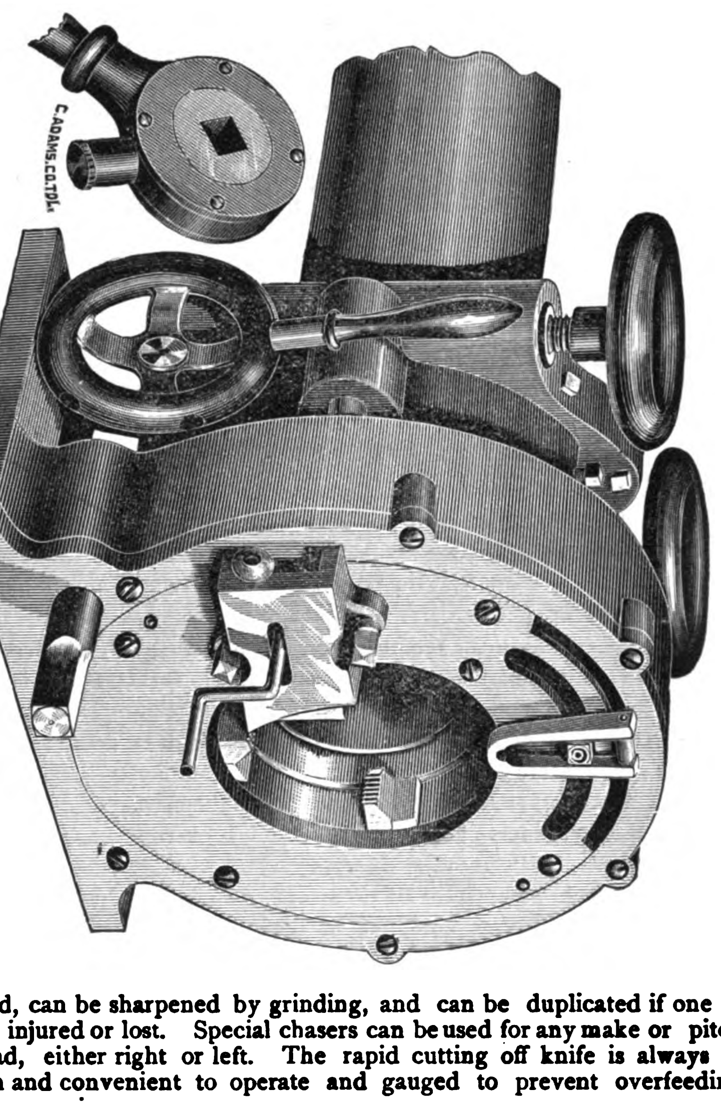
It is painful to all of us so see the awkwardness of the machinist of to-day when it is necessary for him to use a hammer and chisel, but nevertheless he is able to earn a good figure, because he is not awkward in working by the present methods. It is to this modern machinist that I direct these remarks and suggest that he profit by the examples that are to be seen on every hand. The best machinists to-day were born and educated in a time when old methods were practiced, yet have kept abreast of the times by learning every day. The most useless machinist is he who learned his trade in those times, and has given no study to the later methods. It must be acknowledged that some of the older heads that do not now figure conspicuously in the world, possess a fund of mechanical knowledge which is of great value to every one that comes in contact with them.

The better educational facilities of to-day give the younger men a much better start, but nothing can take the place of experience that has been properly stored away in the mind, so there need be little fear of the thoughtful workman being superseded by a younger man that has only the advantage of a mechanical training, although the younger man will always pass by the workman of long experience that has not been thoughtful throughout that experience. The question often comes up, will not the increased educational advantages of the future place in the field workmen who will outdo in every way the machinist who learns his trade to-day? I believe that the true answer is given above. The thoughtful machinist can never be superseded and the indifferent will surely have to take a back seat.

THE WELLS PIPE CUTTING AND THREADING MACHINE.

The accompanying engraving represents a portable, self-contained hand pipe cutting and threading machine, made in various sizes, being one of a number of new machines recently placed on the market by the Wells Machine Works, Fostoria, O.

This is a hand machine so constructed that one person can readily cut off and thread any size pipe, having its mechanism completely housed from dust or accident, using five chasers to a set to insure perfect threads, one set being used for several sizes of pipe. They are released while cutting, and are adjustable to variable fittings. They can readily be removed and replaced, can be sharpened by grinding, and can be duplicated if one or more is injured or lost. Special chasers can be used for any make or pitch of thread, either right or left. The rapid cutting off knife is always in position and convenient to operate and gauged to prevent overfeeding with uneven pipe.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Another feature is a self-centering steel faced vise with collet, forming perfect alignment with the chasers, actuated by rack and pinion with hand wheel and lever, thus giving rapid and easy feed of pipe into the chasers, and quick withdrawal and release of pipe when threaded.

These machines can be readily transported where needed, are very strong and durable, and so simple in construction they can safely be operated by the inexperienced. For further particulars write the above-mentioned address.

Points Concerning Engineering Construction.

Concerning some of the most important points in engineering construction, not a little difference of opinion still exists among equally practical and competent authorities, but in more and more of the essentials this diversity of judgment is disappearing. Thus, basing its conclusions upon returns from the principal locomotive building shops in the United States, aside from the railroad shops, as to the relative number of crown bar, radial stay, and Belpaire boilers built, the *Railroad Gazette* finds a growing confidence, it appears, in the radial screw stay boiler, and finds that the design meets with general approval. It is stated that there is yet to be recorded the first instance of one of these boilers exploding because of the inherent weakness of the stays, but there are a number of cases on record where explosions have occurred as a result of overheated crown sheets, and there would have been, it is asserted, explosions in these cases with probably more disastrous effects if the boilers had crown bars. It appears that during the year ending June 1 last there were built at the Rhode Island Locomotive Works, one of the best known in the country, 131 boilers with crown bars, 72 with radial stays, and six with the Belpaire box—said to be a fair yearly average of the proportion of types of boilers built there.

SPECIAL NOTICE to Readers:

The Premium Offer in the March 1st issue is open to regular subscribers and their friends until further notice.

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THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience experiments. Plain or and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, APRIL 1, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

THE TELEPHONE PATENTS.

The Electrical World says that the expiration of the telephone patents will not be of as much benefit to the general public as most people seem to believe, because the telephone companies have possession of the field, or streets. It is pointed out that the telegraph operates under no patents, yet is a great monopoly, and the arguments made that there is even less opportunity for competition in the telephone than in the telegraph business.

The two can not be placed on the same level, for comparison as to their availability for competitive operations. The telegraph requires an enormous capital to make it sufficiently far-reaching to be serviceable. In this respect it is absolutely unique. The small companies, organized to cover certain territory, even when co-operating in the most amicable manner, found that they were less effective and made less money, than when consolidated.

But the telephone business by no means requires such immense capital for forming organizations complete in themselves, depending upon no other companies for successfully and efficiently performing their work. A company can easily be formed in a city, by the business men, with money enough to provide and carry on a system as extensive as is required to serve the public. It is true that the telephone is useful in proportion to the number of people that can be reached by it, and a new company would not easily get all the patronage of the old company. They would have to build up their business like other people do—by degrees. But the adverse sentiment of the public towards the telephone monopoly would be found a most powerful leverage in favor of the new one. The profits of local companies, notwithstanding all that the directors and papers depending, to some extent, upon their patronage, say to the contrary, are inordinately large.

Let capitalists organize early and bestir themselves to get a large list of subscribers, before the patents expire, and let the city council of every town in which a rival company comes forward, encourage competition, at the same time requiring the new organization to give satisfactory evidence that they are not merely bluffing the old company, and endeavoring only to hold up until "bought out."

Wherever an earnest honest competitive company is started it should be fostered, and if properly encouraged and managed, the expiration of the telephone patents will, in such towns, mean a great saving.

NOT every engineer has an indicator. He should have one, and probably, when the prices of those machines fall, in the course of time, which improvement and competition will very likely bring about, he may be able to own one. However, it is the duty of every engineer to know something about the indicator. A knowledge of its workings and of cards can be readily gained by procuring a good work on the subject. "The Indicator," by W. B. Le Van, is one of the very best works. H. C. Baird & Co., of 810 Walnut street, Philadelphia, Pa., publish it. A description of it will be found in our advertising columns.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(347.) B. H. Strickler, Timberville, Va., writes; "Please answer me in your next edition the best and easiest way I can melt 10 to 20 pounds of old brass for castings in a crucible with a blacksmith forge, and how much borax to use to 10 pounds of brass for a flue. Must the borax be put in at first or wait for the brass to get red hot? Also, what can I put in the sand to make good cores for brass castings? Is it necessary to put charcoal on the brass in crucible when melting?" *A.*—You can melt the brass in a forge by surrounding it with coke, also covering crucible with the same. Place borax in when hot. Mix the sand with one tenth part flour.

(348.) "Machinist," Three Rivers, Mich., writes: "Would you please inform me through your paper the best way to fasten numbers on brass patterns, or any metal pattern without drilling and putting on with pins or rivets?" *A.*—Make a solder of half bismuth and half common solder. File it into fine powder, sprinkle powder on where you wish letters affixed, place your letters in the position you want them, and then with a blow pipe, put on a mild flame. The solder will melt and affix the letters, but the heat necessary to do this will not melt lead letters. Another way is to dig out the letters on the bottom, to make them a little concave. Drill a hole in, tin the places where letters are to go, and when you have them in position, pour solder in the holes. It will run over, but not much, if carefully done, and the solder can be filed down even with the letter.

(349.) Aerial Navigation Co., Brightwood, Ind., writes: 1. "Will you favor me by informing me where I can buy aluminum cheapest and whether it is pure, that is, is the quality as good as any other aluminum? Some firms are selling cheaper than others, by this I believed the cheaper article was the inferior one. 2. Also inform me which is the best fuel oil for firing a steam boiler, and oblige." *A.* 1.—We are not informed where the cheapest can be bought. There are several aluminum companies. We do not know the quality nor price of the product of every one of these concerns, but we think that the product of the Cowles Co., of Lockport, N. Y., and of the Pittsburgh Reduction Co., will be found all right, whatever the price. By this we do not mean that the same cannot be said of the goods of other companies. Perhaps some reader can give the inquirer a simple method of testing the quality of aluminum. 2. The Cleveland City Cable Railway Co. uses Lima crude oil, and considers it as good as any other.

(350.) J. E. Smith, Stafford, Ct., writes: "I would like to know through your 'Questions and Answers' column how much per cent. is lost in the bridges being down under too large boilers. I am troubled a good deal in making steam. I am using wood for fuel and have been firing two years without any bridges." *A.*—There is not a great deal lost by the bridge wall being down. It was originally designed to keep coal and ashes from going into the combustion chamber, and by having one you can keep the most of the ashes and fire where they will not interfere with cleaning it, enabling you to perform that operation at any time.

(351.) F. C. E., Keats, Kans., writes: "I am well pleased with the book and the papers, so far. If every subscriber has a chance to ask questions, I have one to ask. Pease tell me where I can get self-hardening steel for lathe tools?" *A.*—Ask any hardware dealer for Mushet steel. If he does not keep it he can get it easily.

(352.) J. L. H., Stryker, O., asks: "Being a subscriber for your excellent paper, I would be pleased to have you tell me through 'Questions and Answers' to settle the following controversy between myself and my employers. We are erecting a large water tank on the roof of our engine-room, to fill the boiler and for other purposes. There will be a hose connected with the bottom of the tank to use in case of fire. My idea is that the pressure in the hose will be no greater in a tank of large diameter than one of smaller diameter, if the elevation and depth of the water are the same. They are trying to make me believe that the tank with the largest diameter will throw water farther from the end of nozzle. Which is right?" *A.*—You are right and your employers wrong.

(353.) G. E., Milwaukee, Wis., asks: "Will you please inform me through your 'Q. and A.' column what to put on tracing cloth to produce a gloss. In erasing the gloss is rubbed off, and in a very short time the spot becomes soiled. I thought perhaps you could help this by telling me what to put on after having erased?" *A.*—We can only request any reader who is able to answer this to do so, as we can not.

☞Readers are cordially invited to send us any questions, comments, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—ED.

ONE of the latest improvements in railway science consists of a small dynamo and an auxiliary engine placed upon the locomotive in such a manner as easily to be operated. A current of small force, but large quantity, is made to pass from one pole of the dynamo to one pair of driving wheels, thence to the other pole of the dynamo. This method is said to show an increase of 400 per cent. in the hauling power of the locomotive.

DIE-MAKING.

Following in the footsteps of a previous communication, on how to make a die for the punch press, I will undertake another on the same subject, in which I will introduce some of the difficulties attendant on this class of work, and how to overcome them. Also to present some useful hints upon the manner of applying the die to actual use in the press. In order to convey to the readers details of this important subject understandingly, I am obliged to make use (in no ordinary degree) of time, space, and language, but will try and limit these to a reasonable extent, lest I become monotonous and my purpose be lost.

To be a successful die-maker it is incumbant upon us to know something of the nature of steel. It is not necessary to advance the whole theory and process of manufacturing, for that would require a large volume. It will suffice for us to know that steel undergoes great changes by the use of heat and cold, and to know what those changes are in actual practice. "Experience," the greatest of all teachers, determines them. Different changes occur under different circumstances, and they are so varied that it will be impossible for us to undertake the task of describing all of them, so we will confine our remarks to special cases, taking examples of a simple nature and following them carefully.

We wish to make a die of the following dimensions 3" x 9" x ¾", the aperture to be ⅜" x 5". It will be observed that when finished this block of steel contains a long, narrow slot, and experience teaches us that in all cases, a certain amount of shear (whether the metal we wish to punch be thick or thin) is beneficial when possible to obtain it, the strain on the press and die is sensibly reduced, the cutting edges will keep sharp longer, thereby producing a greater quantity and a better quality of work. Therefore, at this point we think it advisable to state the rule for the shear of any die. The shear should be equal to the thickness of the metal to be punched. Thus, if we have ⅛" metal, we must have ⅛" shear, that is, the die to be ⅛" higher in the center than it is at the ends of its cutting surface.

After we have this die ready for the forge, let us examine it carefully to prove that our work is right, by taking a straight round rod ⅜" diameter, and length of the aperture. We can just push it through in a parallel position and it has a bearing the whole length. It also has 1/32" clearance on each side, then we conclude it must be right, and proceed to harden it. Now, this die is long and narrow, and we must use extreme care, or our former labor will be lost. If the water be very cold, it is a good plan in this case to have the chill taken from our large tub of salt water, by previously heating a piece of iron (the size depending on the quantity of the bath) and moving it slowly around in the bath just long enough to temper the water, but not to make it warm. After heating properly, and immersing slowly in a perpendicular position, we take it to the bench and examine it again, when to our discomfiture we find it is all out of shape, our straight rod will not go through, it is small in the center of the slot, and large at both ends. We find also that the sides of the aperture have become convex and the whole die is curved so that if we lay a straight edge on the bottom side, 1/16" will not fill the space in the center. After taking so much pains with our work we feel disgusted and the questions that arise are, why this great change, what is the cause, and how can we prevent it in the future?

It is easier, we confess, to write the remedies than to perform them. By the aid of some well tried theoretical and practical experiments we will undertake the task of solving these problems. If a piece of cast steel be broken before it is hardened, and again after hardening, in the latter case it will be found that the particles have gathered themselves together, or contracted, presenting to the eye a finer grain. Under these circumstances it can be easily seen that the surface first coming in contact with the cooling fluid will be more contracted than it is beneath the surface or in the center. Also, that if any part be heated more than another it will be more contracted at that point, thereby springing the whole mass out of shape. There are two means that we will employ to overcome this difficulty, viz.: the proper use of heat and cold. For example, if a bar of steel be round, or flat, or square, and the surfaces parallel, it should be immersed in a perpendicular position, but if it should have raised portions, causing more metal to be on one side of a central parallel plane than the other, then it should be immersed in an angular position, the incline being toward the side that contains the most metal. Again, the same result can be obtained in the fire by heating to a greater degree of heat the same side, and immersing perpendicularly. By carefully heeding these rules we are confident of our ability to produce the work in a satisfactory manner.

We now come to the aperture in the die We will not be able to overcome to any great extent the rounding surface of its sides, nevertheless, we propose to have it straight and perfect in every particular. In order to do this we shall have to go back to its construction. We will not allow the straight rod to go through it, as spoken of, but make it a trifle smaller than the desired size, then procure some asbestos and insert it in the aperture filling it full, and with a punch hammer it in solid. This is an indestructible material in the common fire. Let us now note its office. We find that the die is hard in the aperture only about ⅛" from the surface, the balance being soft. The cause of this is easily explained. The asbestos being compact the water penetrates only that depth. Now we can file it with ease, and where it is hard, using the oil stone, we soon have it perfect.

Having the die ready for use it is then clamped in the shoe, which should be heavy and not liable to spring by the pressure to which it is subjected. If it should spring then liners must be put under it to make it solid and firm when bolted down. After testing the head or slide of the press to see that there is no lost motion, and clamping the punch in its place, we set the die so the punch will go in nicely about 1-16" below the surface, and clamp it solid. If the metal to be punched is heavy, there will be a constant jar of all the parts, and to prove that we are right place some of the metal over the die, and bring the punch down by hand pretty solid, two or three times, but not hard enough to punch it through. Take out the metal and see if the punch and die remain in their right positions. If not, then repeat the operation until they are right. A great many make mistakes at this point allowing the press to run by power, and in a short time the punch and die have sheared their edges becoming useless until ground and refitted. Time and care taken in the right place are never lost. KINKS.

SOME POINTS ON ENGINE REPAIRING.

BY C. H. RICHARDS AND V. L. STOCKTON.

The engineer not having much experience, is often at a loss to know just what to do in case of his engine wearing, and it happens not infrequently that when some repairs are necessary, neither the engineer nor the machinists who is to do the work knows how to do it.

It is always well—in fact it is the duty of an engineer that can not be neglected except at much cost and possibly accidents—to look carefully to lubrication and keeping set-screws and keys properly tightened and an eye generally upon every part of the plant. The cups should all be kept feeding nicely, the crank-pin brasses and cross-head should be frequently examined and felt of to see that they are not too warm. The valves should be examined frequently—also the piston and cylinder. Unless this is done, trouble may arise and get far advanced before noticed in the working. This should be done once a month in any case.

Therefore we send to the editor of the SCIENTIFIC MACHINIST some hints to repairers of engines, and the engineer can often act as such himself, especially when the difficulty has not become serious.

When the valve faces wear, or become abraided, we recommend that they be filed, crosswise of the cut. It will be found that they will then wear down evenly and make a good seat. A part of the seat, as every engineer knows, is never uncovered, and is very difficult to lubricate on that account. We have for years cut grooves in this valve face, almost but not quite through, about one inch apart. This lets in the steam and the seats become lubricated. There are some builders making their valves this way now. They should all be made so.

The piston and cylinder quite often get scratched and cut. The priming of the boiler will carry grit and sediment into the cylinder and it may get there in other ways. When the rings become cut, take them off and file, as before stated, across and not with the scratches. When replaced, make a nice bearing. Many make them too tight. They had better be too loose than too tight.

The rod will cut if the packing is left in too long, or if the glands are not properly tightened. When this occurs, scrape the scratch, lengthwise of, or with it. If no scraper is at hand, use a file, but be careful to do a neat job. Be sure and repack and see that the glands are right—neither too loose nor too tight—and do not bear on the rod.

There is more trouble, in certain classes of engines, with the crank pin than with all other parts. If it gets hot, look carefully to the lubrication, and if the oil feeds properly you will probably find that the brasses are cutting. When this is found to be the case, take off the brasses, and if the pin is not much cut, use emery paper on it until smooth, or file it if necessary. Also file the brasses. If it is quite loose new brasses should be put on, and if they can not be had, the best thing to do is to drill holes in the brasses and pour in babbitt metal. This often makes a better job than new brasses, but should be done carefully. The babbitt plugs may slip out if not hammered in. If you want to fix them in so tightly that they can not come out by any means, drill your holes with a drill ground off at one side, so as to make it crooked, or larger at the bottom than the top.

The cross-head sometimes gives trouble. When it slips up and down between the sides, and is loose, it shows that it has worn the lower brasses, and as a consequence the piston has dropped and is out of line. This has a tendency to cut the piston, and if out of line to a great extent, will cause very serious trouble. Liners should be put in and the cross-head properly raised until it is not loose.

There are a great many more points about an engine that we would like to speak of here, but can not. We will, later on, show some of the most common troubles found in repairing engines. These remarks are directed jointly to the engineer and the machinist, or any one who may have to do with engines.

New English Engine Regulations.

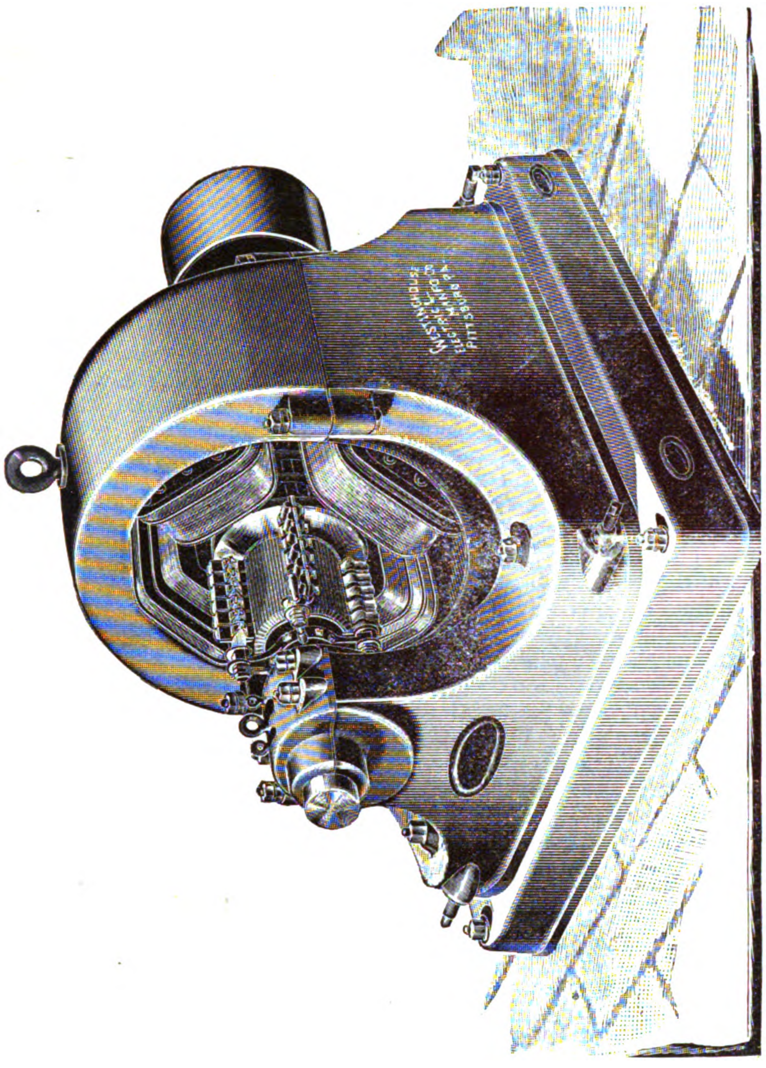
Some valuable practical regulations have recently been published by the English builders of a high-speed engine said to run satisfactorily at 700 revolutions per minute and to develop 200 horse-power. According to this, if the boiler pressure always exceeds 70 pounds, it is worth while to use a compound engine, and, if as high as 150 pounds, a triple-expansion engine. If the engine exhausts into a vacuum the corresponding pressure will be about one-fourth lower—the extent to which the steam may be expanded with advantage depending upon the boiler pressure: if the expansion is carried to more than a certain number of volumes it is advantageous to divide it into two stages—that is to expand partly in a high pressure or small cylinder or cylinders and partly in a low pressure or large cylinder; with still greater expansion, it is worth while to expand in three stages, that is, in three successive cylinders of increasing diameter, and so on. It is admitted, however, that, although there are great practical and economic advantages in the system of expansion in successive stages, there is no essential difference in principle between expanding, say, eight times, in a series of three cylinders, with comparatively late cut off in the first or smallest one, and expanding eight times in the largest of the three only, with the steam admitted to it direct and cut off at one-eight stroke.

THE Mechanic's Handy Apron will be found a very desirable article for the money. See notice of it on last page.

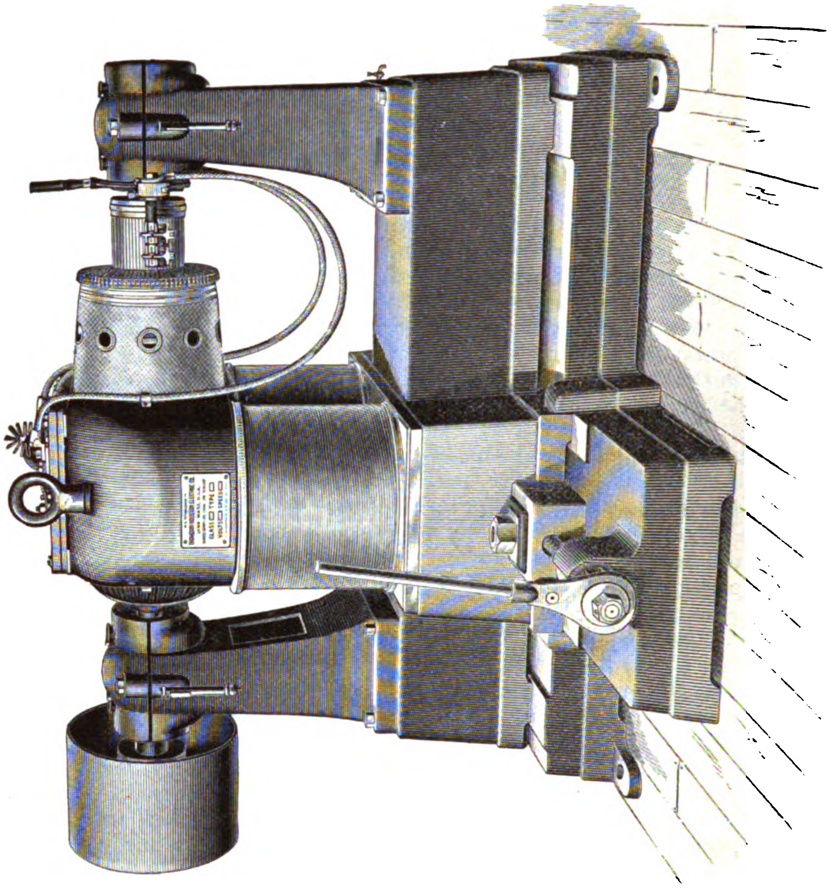
Electrical

Some of the Principal Machines.

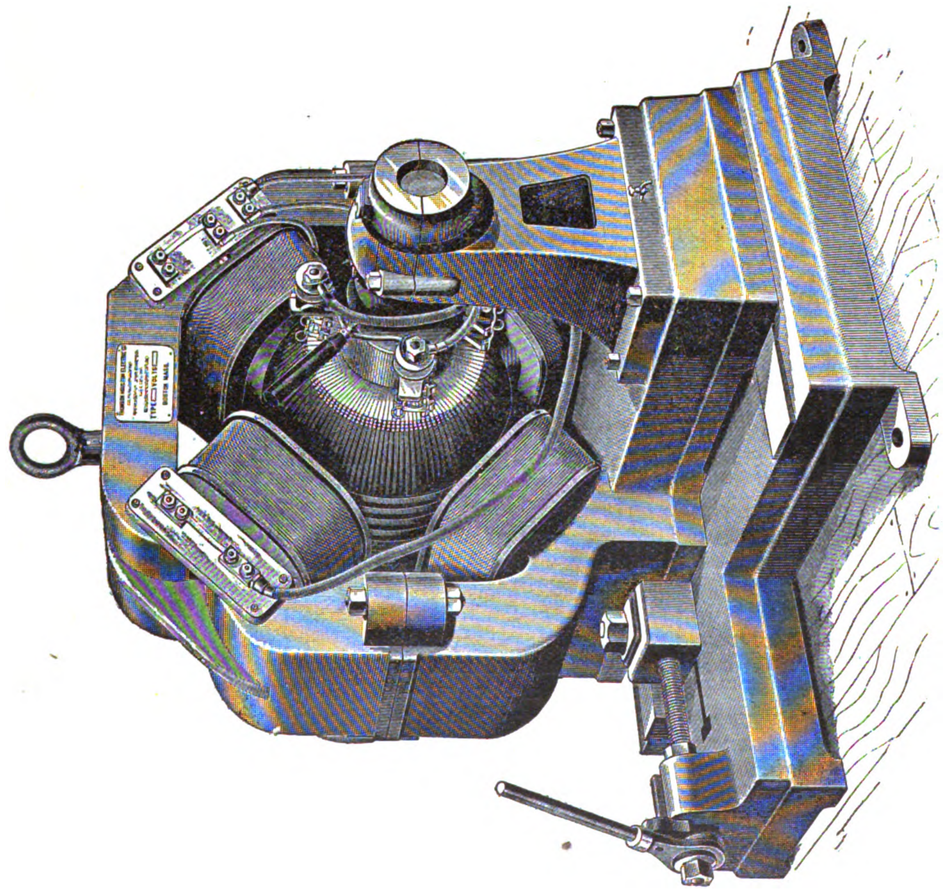
The first type of railway generator brought out by the Thomson-Houston Electric Co., was a two-pole machine of the motor type pattern, having an output of 62,000 watts, which was followed by a generator of the same type, having an output of 250,000 watts. The general construction of this machine can be readily seen from the accompanying illustrations.



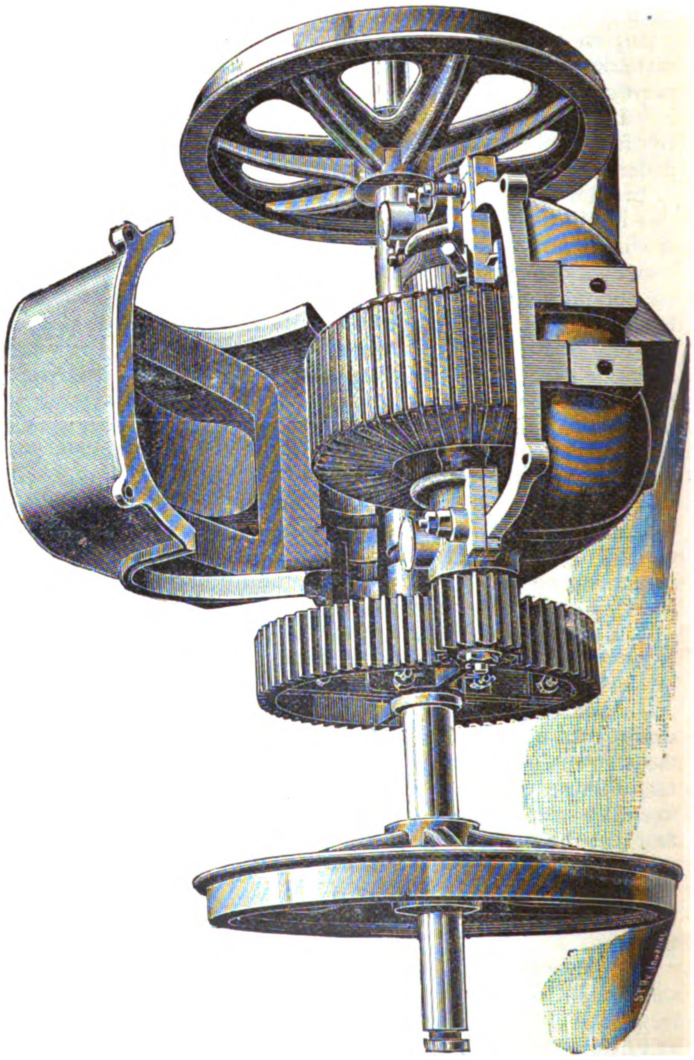
WESTINGHOUSE RAILWAY GENERATOR.



THE "D-62" GENERATOR.



THOMSON-HOUSTON 250 M. P. RAILWAY GENERATOR.



WESTINGHOUSE SINGLE REDUCTION MOTOR.

The armature of the M. P. 250 dynamo is of the ring pattern, and so constructed that opportunity is afforded for better insulation than can be obtained with other types of armatures, and the danger due to great difference of potential between any two of its conductors is avoided. In case of accident or injury to any coil, it can be easily repaired without affecting in any way the remaining coils. The construction of this armature affords the best possible ventilation.

One of the most important features of this generator is the arrangement for lubrication, and good alignment of the bearings. The boxes are made in two parts and are entirely separate from the stands. On the top of the stand is a seat into which the spherical surface of the box fits and in which the box is free to move. The bolts which secure it to the stand are smaller than the holes which are drilled through the box, so that a slight play of box in the seat is permitted.

The bearing shells or linings are removable, and are made in the following manner.

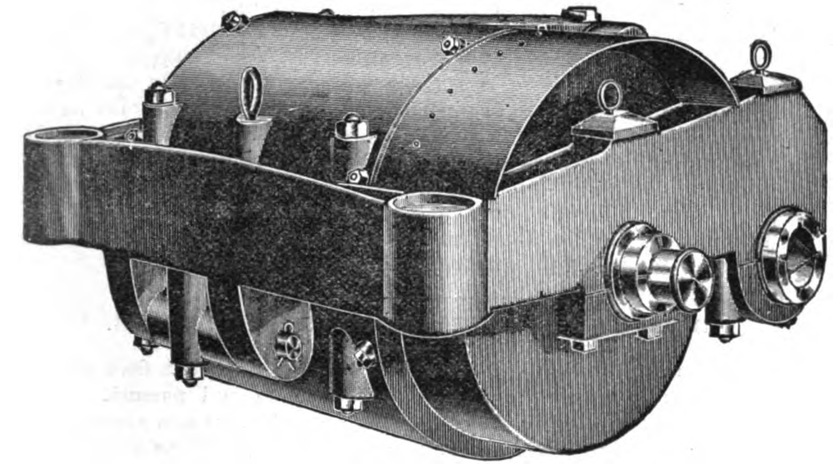
A skeleton shell of brass is made, the interstices of which are filled with magnolia metal. This is then bored and reamed to size, oil-ways being cut so that the oil circulation begins at the point where the oil rings touch the shaft. In order that the outboards bearings may be perfectly aligned with the other bearings, the stand of the extension base has two adjustments, one in a horizontal and the other in a vertical direction. The movement of the brushes is affected by means of the shaft on which a small worm is attached, and which in turn works in a rack fastened to the yoke. By means of this a very fine adjustment of the brushes can be made. The worm locks the yoke so that it cannot be moved except by hand.

The commutator, which has 180 sections, is designed and constructed with great care, and in practice has been satisfactory in every way.

In practice, this dynamo will have its fields separately excited, although the connection at the switchboard is so arranged that by throwing a switch the dynamo can be made self-excited, should emergency require it.

The "D-62" generator, as it is called, is of the familiar motor type and is one of the machines most frequently in use for railway work, its output being equivalent to about 80 mechanical horse-power. The frame is strong and well proportioned. The bearings are massive and easily accessible, and constitute one of the especially distinctive features of the Thomson-Houston machine. They are spherical, self adjusting and self-oiling, which exempts them from attention for weeks at a time. They are interchangeable.

The armature is easily removed when desired. All electrical connections are made on connection boards which surmount the pole pieces, where they may be readily inspected. The current is taken from the commutator by carbon brushes, which have proved themselves to be more satisfactory than anything else yet found for this purpose.



THOMSON-HOUSTON RAILWAY MOTOR.

The construction of the commutator itself, as well as the unusually large factor of safety which is employed in the insulation of the wires, indicate, perhaps, as well as anything else, the evolution due to the extensive experience of the Thomson-Houston Co. in dynamo manufacture. This company has long had a reputation for the reliability of its high tension machinery in both its arc lighting work and in the alternating system of incandescence lighting. With but 500 volts as the limit of pressure, therefore, it is natural that their experience with insulating material has enabled them to construct a machine which is of marked superiority in this respect. Another larger generator of the same type as the "D-62" has been recently designed, which has an output of 100 horse power. This machine is known as the "D 80."

The length of the armature shaft is such that the motor may be used to equip roads of three-foot gauge, while its dimensions from the nose plate to the center of the axle bearings is so small that two may be mounted on a truck with only a five-foot wheel base.

The frame consists of two castings of steel clamped together by bolts at the front and back, the axle brasses being held between the two parts. The armature bearings are cast in one piece with the lower half of the frame, and are provided with caps so that the linings may be inspected or renewed without disturbing other parts of the machine. The lower half is shaped something like a bowl, rounding up from a plow-shaped bottom, which will throw aside stones or other obstructions which may be upon the track. The parts of the frame are hinged together at the axle end, and by removing four bolts the upper half may be raised through a trap in the car floor, or the lower half swung downward into a pit under the track, whichever may be most convenient. The field coil or armature can then be easily removed. The motor can be run through or stand in water up to the lower side of the armature bearing without damage, and water may freely drip on the top without danger of entering it. All the metal in the frame of the motor forms a part of the magnetic circuit, and dead weight is thereby avoided.

The armature pinion and axle gear are of steel of ample width of face, and are run in an oil-tight case filled with grease to insure free and continuous lubrication, and to exclude dust and grit. The gear case is made in two parts and has a small opening on top, fitted with an oil-tight lid, through which the gears may be inspected and oil introduced. By loosening the nuts on two hinged bolts, a section of the case can be removed and the pinion on the armature shaft drawn off, without taking apart the gear case proper.

The armature shaft is made short and heavy, to avoid the possibility of springing, and is fitted with steel shells on its bearings, which, in case of wear from long use or scoring from grit in the boxes, may be replaced and a proper bearing therefore always insured. The linings of the boxes are of punched sheet metal just thick enough to stand the wear required of them, and when thrown away and replaced by new ones but little metal is wasted. The armature, as well as the motor, is entirely iron-clad. The armature core is a ring with projecting teeth of a peculiar form, solidly fastened to the shaft. The coils are wound between the teeth and firmly held in place by wooden wedges. The winding is continuous, and the joints in the wire are made by electric welding. The armature winding is such that there is no crossing of wires, and, as it is below the surface of the iron core, it is protected from any mechanical injury arising either from any foreign substance getting between the armature and pole pieces, or from the rubbing of the armature against a pole piece on account of wear of the brasses. The one field coil of the motor is above the armature and exerts upon it a solenoidal pull, so proportioned that, at normal load, the armature is lifted and its bearings relieved of its weight. The iron-clad armature permits the use of much less clearance between the armature and the pole pieces than was safe where the armature was wound on the surface, and the smaller air gap materially decreases the magnetic resistance of the circuit. This means less weight and less heating of the field spool, and that a smaller motor will perform more work on account of greater efficiency.

The brush holders are mounted in slots, planed in the inside face of the frame, on each side of the armature bearing. By giving a quarter turn to a handle on the brush holder it may be taken from the motor to examine or renew a brush.

In the Westinghouse railway generator there are four pole pieces, and over each one is slipped a metal bobbin, which is secured in place by bolts. The bobbins carry the shunt and series coils, which are put on side by side and do not overlap. The pole pieces are laminated, being built up of thin sheet-iron plates cast into the cylindrical yoke. The bearings and this cylindrical yoke part along a horizontal plane through the armature shaft, thus giving ready access to the field-coils and armature.

The supports for the bearings are cast in one piece with the lower half of the field, a construction which gives great strength and rigidity to the bearings and secures the greatest possible freedom from vibration. Access is had to the armature by unbolting and removing the upper half of the field casting.

The bearings are self-oiling. A large reservoir below each bearing holds a quantity of oil and the oil-rings in the bearings, which revolve with the shaft, carry a bountiful supply of lubricant up to the bearing during the time when the generator is in operation. The oil is thus automatically used over and over again until it becomes dirty, when it is drawn off through a stop-cock and the chamber filled with a fresh supply.

Automatic alignment is secured by the use of ball bearings, which adjust themselves and can never bind on the shaft. This combination of self-oiling and self-aligning bearings commends itself at once.

Each brush is held in an independent holder, so that any one can be raised from the commutator without disturbing the others; and each brush has its own spring, which permits perfect adjustment. The diametrically opposite brushes are of the same polarity, and are connected together. The rocker-arm of the brush-holder is of rigid construction, and the different parts are perfectly insulated.

The type of armature used is the drum or Siemens. The core or body is built up in the usual way of a number of thin discs of soft iron which are forced together under pressure and rigidly keyed to the shaft.

In this form of armature each wire is placed in a separate cell composed of insulating material, and these cells are embedded in the iron in such a way as to hold the wires absolutely firm and to prevent them from coming in contact with each other. This construction also avoids the use of bands or binding wires, and the surface of the finished armature presents the appearance shown in Fig. 2. The distance between the iron in the armature and that in the pole pieces is also decreased with a corresponding gain in the efficiency of the generator.

The commutator, which is very long and massive and affords ample contact-surface for the brushes, is built up and insulated in the most improved manner.

All the generators are reversible on their bed-plates and can be run in either direction by making a slight change in the connections. The bed-plates are provided with ways on which the machines travel, when it is necessary to increase or decrease the tension of the belts.

Tension screws, provided with removable levers for operating the same, give the means of moving the machines back and forth.

The Westinghouse single reduction motor has four pole pieces, which project radially from the interior of the cylindrical yoke. The field coils are slipped over these pole pieces and held in place by a flat brass ring, which is bolted to the yoke.

The cast-iron frame on which the motor is mounted is a distinguishing feature of the Westinghouse motors. This frame is rectangular, in one casting, and made very strong at the points subjected to the greatest strains. All parts of the motor are made interchangeable. By means of the frame the armature shaft and car axle are maintained in perfect parallelism, and consequently perfect meshing of the gears is obtained. This frame, extending entirely around the motor, and suspended at two corners on springs, distributes the strains and prevents the abnormal wearing of the bearings.

To remove a field coil, the upper half of cylinder, or the lower half, as the case may be, is swung back, the coil slipped off and another put in its place. To remove an armature from the motor, the lower half is swung back, the bushing caps removed and the armature lowered into the pit.

The armature is of the drum type, having a body built up of a large number of thin iron discs, secured to a substantial shaft. These discs are of such a form that when the armature core is complete, the surface presents a number of grooves running its entire length, parallel to the shaft.

The wires, instead of being wound by hand directly on this core, are first made up into coils of such a shape as to fit into these grooves. Each coil is most carefully insulated, and is then driven tightly into place. From this it follows that the coils are removable, and in case of accident an injured coil may be removed and another put in its place by an ordinary car mechanic. Again, the wires being imbedded in iron, it is impossible for them to be moved, be it ever so slightly, by vibration or by the reaction when starting a heavy car; nor can the winding be injured by ordinary external causes.

The iron of the armature core extends to the surface and the distance between the iron of the armature and that of the fields is practically no greater than the mechanical clearance of the armature.

The brush holder consists of a composition casting, bolted to the motor frame, which carries two square oak pieces. These pieces form the support, and at the same time the insulation, of the brush-holders proper. The carbon brushes (two in number) are held against the commutator by springs, which admit of adjustment, as needed.

The split gear and pinion are of usual width of face, and are of great strength, both as to construction and material. The covering which encloses the gears is made dust-proof and is intended to contain a suitable quantity of lubricant, thus increasing the life of the gears very materially.

SKINNER'S NEW INDEPENDENT LATHE CHUCK.

We illustrate herewith the Skinner independent, reversible jaw lathe chuck, upon which a patent was issued November 17, 1891, to the Skinner Chuck Co., New Britain, Conn. In design and construction it differs from every other independent jaw lathe chuck. The body of the chuck is made of one casting, the face of which is unusually thick where the thrust of the screws come, and where the ways are in which the jaws run. The chuck is very strong, but is so designed as to be quite light to handle, and not unnecessarily to load the lathe spindle. The construction is such that the chuck and work can be brought near to the head of the lathe, securing greater accuracy and allowing more capacity to the lathe. The hardened hub or bushing, which is peculiar to this chuck, receives the end thrust of the jaw screws when work is held on the outside bites of the chuck. The hub is threaded into the chuck body, and when in place helps to strengthen the chuck by binding the body together and resisting the strain of the jaws. When the jaws are to be reversed the hub is removed with a key wrench provided, and the jaws are run towards the center until they will leave the screw, and can then be reversed. The nut, which contains a full thread, being solid and a part of the jaw, gives a gripping power unequaled in any other independent chuck. The jaw screws, which are of steel, have the United States standard shape of thread. These chucks are built in sizes of even inches from 4" to 42". All chucks 12" or larger have suitable slots in the face for bolting on irregular shaped pieces and make the chuck body useful as a face-plate. Fig. 1 shows front of 6" to 10", inclusive. Fig. 2 shows front of 12" to 24", inclusive. Fig. 3 shows front of 24" to 42", inclusive. Fig. 4 shows back of 24" to 42", inclusive. Fig. 5 shows a section with the center hub removed, also one of the jaw screws removed (with the jaw reversed), showing clearly the full threaded and solid nut.

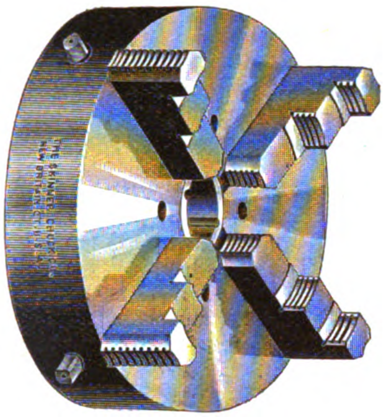


FIG. 1.

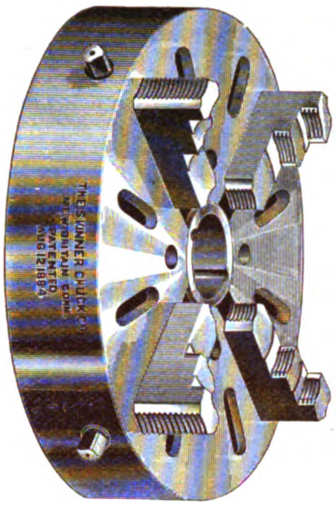


FIG. 2.

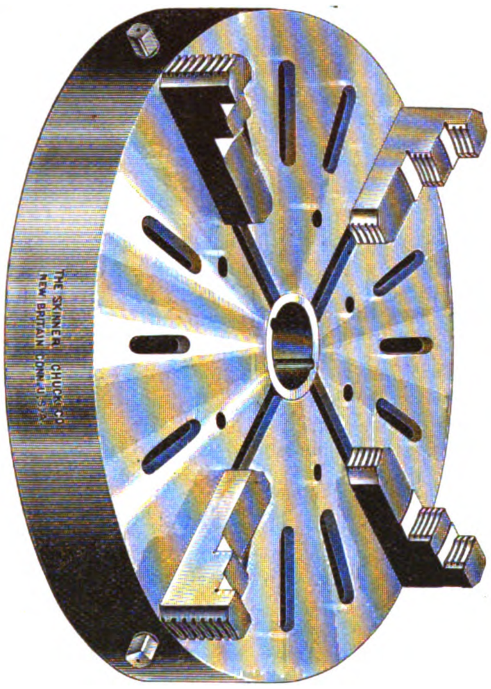


FIG. 3.

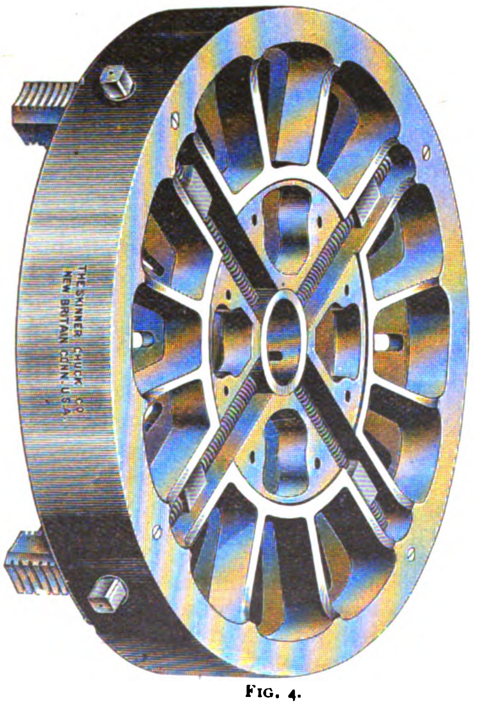


FIG. 4.

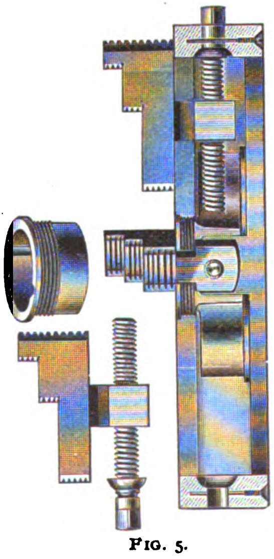


FIG. 5.

THE *Art Interchange* for March is filled with exquisite paintings and drawings, and valuable information for art workers and for those interested in home decoration. A lovely water color is a Venetian scene, entitled "A Shrine on the Lagoon." A second painting in color is an oil reproduction of a brilliant picture of purple and white clematis; a third painting shows cupids, the last-named is invaluable to china painters, and those engaged in decorative work of all kinds. Beautiful engravings of famous paintings and designs for art work fill the pages of the magazine. Price of this issue, with the three colored pictures, 35 cents. It is published by the Art Interchange Co., 9 Desbrosses street, New York. It is the leading art journal of the world for amateur and professional artists.

BURTON'S ELECTRICAL FORGING PROCESS.

The production of heat by electricity is creating a distinct field of invention, that electrical experts are not slow to enter in and possess. Electric welding has already taken its place in the industrial ranks as a process that is here to stay; electrical warming of houses and cars, and the production of heat for culinary purposes are making their way to a permanent place. Another process, whose success is already demonstrated, is that of electrical forging—the heating of metals to such a temperature that they can be readily forged by machines connected with the electrical apparatus. This is an entirely different operation from that of electric welding. It is the invention of George D. Burton, of Boston, who is now credited with 100 patents. He is known to the country at large through his invention, in 1880, of the car for the humane shipment of live stock over long hauls.

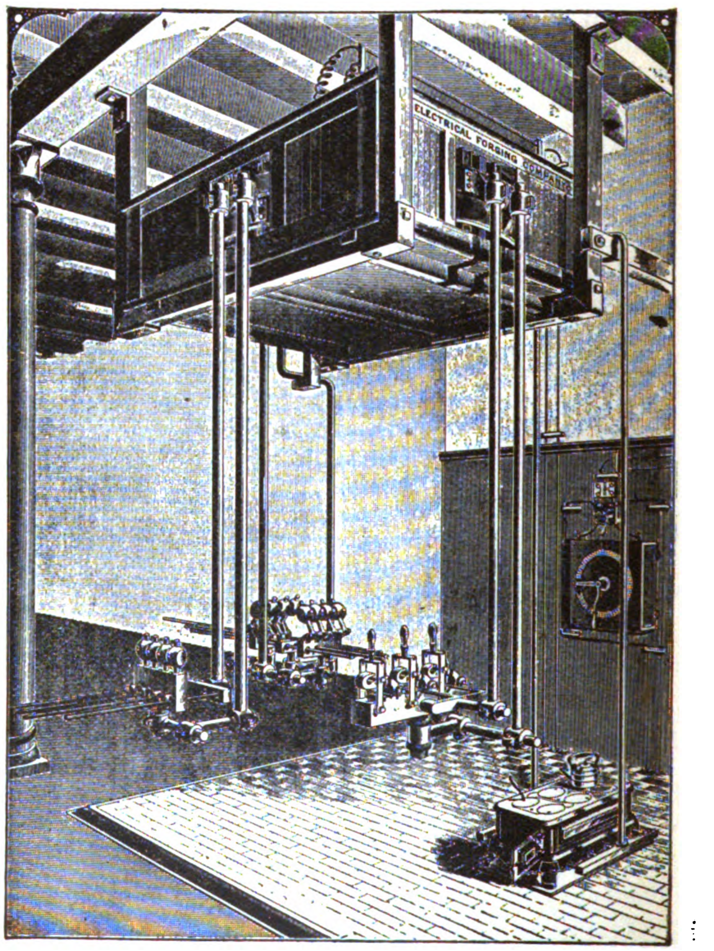


FIG 2—LARGE FORGING CONVERTER AND ADJUSTABLE CLAMPS.

The practicability of the process covered by Mr. Burton's invention has been fully demonstrated during the past year by the Electrical Forging Co., under which title the Burton Co. is known, at their factory, 163-169 Oliver street, Boston. The Electrical Forging Co. was organized February, 1890, with a capital of $2,000,000, divided into 20,000 shares.

Instead of heating the metal at the ends for the purpose of effecting union between two pieces of metal, as in electric welding, the electrical forging process is to heat, if required, a solid bar, rod or blank, of a determined size or length, in its entirety, and, when properly heated, the bar or rod is passed automatically between dies, rolls or other shaping devices, for the purpose of ving the necessary shape to the thing produced. Both the constant and intermittent current is used according to the class of machine and nature of the work to be done.

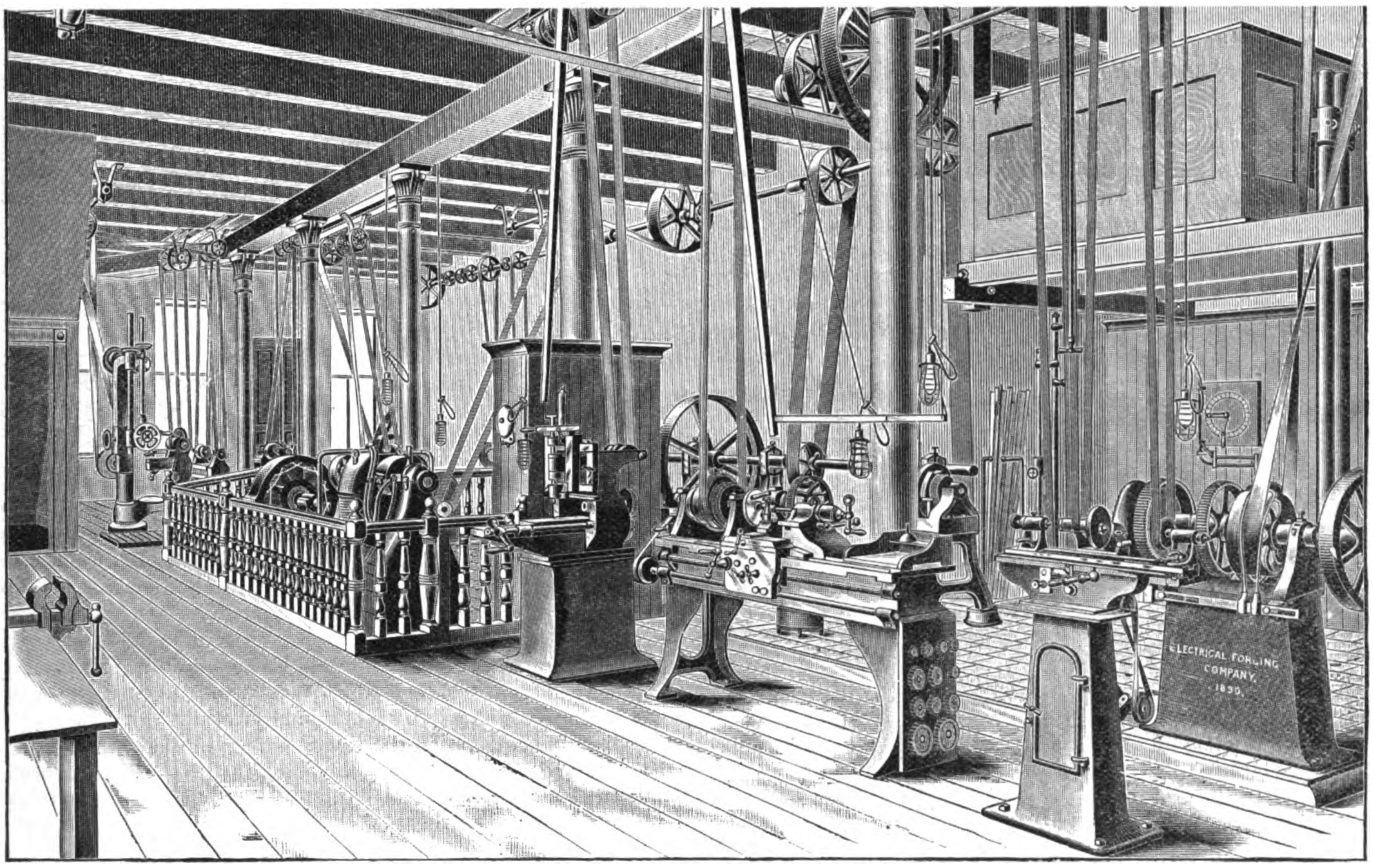

ELECTRICAL FORGING COMPANY. 1890.

Fig. 1.—GENERATING ROOM, BURTON ELECTRIC FORGING WORKS.

Fig. 1 is a general view of the generating-room on the first floor of building, and shows also one of the converters and a number of special machines for shaping the metal after heating. It should be stated here that from the first alternating currents have been used in conjunction with large converters capable of developing enormous amperage. The generating plant, proper, is contained within the portion of the building surrounded by a railing, as shown in the drawing, and consists, first, of a 60 horse-power Thomson-Houston motor, which receives its current from the regular street circuits of the Edison Illuminating Co., of Boston. This motor is belted to a line of shafting carrying one Emerson power scale with meter attachments for accurate measurement of horse-power consumed. From this line of shafting is driven a 60 horse-power alternating generator and also a small exciting machine for the fields of the generator, as shown in Fig. 1. This main shaft also drives the main line of shafting shown at the top of Fig. 1 which operates all the tools and forging machines both on this floor and in the basement below. The generator is specially wound to develop 24 amperes at 1,500 volts, and the current is controlled by a two-way switch, which throws it either into the converter shown in the upper right-hand corner of Fig. 1 and in detail in Fig. 2, or into the converter in the basement as shown in Fig. 3.

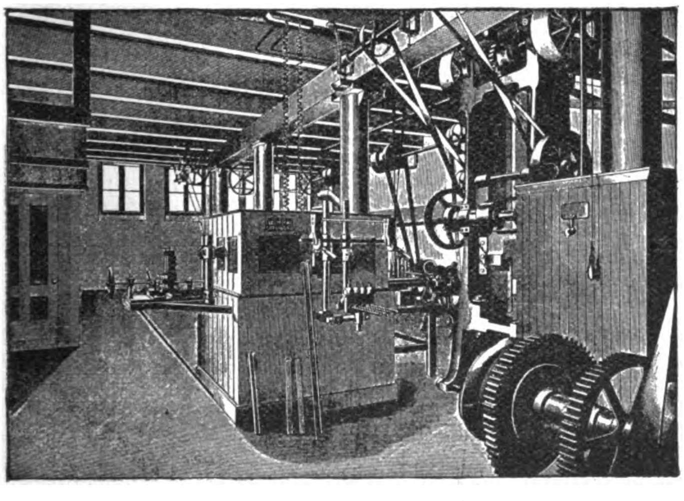


Fig. 3.—CONVERTER IN BASEMENT.

The converter has a capacity of 60 h. p., and is designed to deliver current at 5 volts and from 5,000 to 8,000 amperes. From the rings above described, this enormous current is conducted by three sets of heavy copper bars, (as shown in detail in Fig. 2) to special electrodes provided with automatic adjustable clamps, in which the heating of the metals takes place. These electrodes are, as shown in Fig. 1, conveniently situated amongst machines for rolling balls, rivets and other kinds of regular and irregular shapes, the metal being heated and then passed into the machine. The electrodes shown in Fig. 2 are of special design, and vary according to the kind of work to be done. In certain cases where end heat is required, the clamps on the electrodes of one polarity are provided with a number of holes, through which a number of metal rods can be inserted, as shown in the figure. When these rods come into contact with the electrode of clamp or the other polarity, they are heated in a few seconds to a forging heat, and while one heated rod is being worked by the rolling machines, the other rods are in the process of being heated, the machines being thus fed with a constant supply of heated metal. The capacity of this converter is about 1¼ inch steel, round or square, and four bars of this size can easily be heated at the same time. A complete outfit, however, has recently been shipped to England, and another to Canada, which will heat a bar up to 5 inches square and 3 feet long, throughout its entire length in about five minutes, with an expenditure of from 75 to 100 horse-power.

Some of the things that have been done by the Burton process will indicate its efficiency:

A round bar of tool steel, ⅞ inch diameter and 11 inches long between the clamps, is raised to the proper forging heat in one minute by 32 h. p.

A flat bar of machinery steel, ¼ inch thick, 1 inch wide and 17 inches long, is heated in one minute by 34 h. p.

Balling stocks for balls, tool steel ½ inch diameter and 5 inches distance between the clamps, is heated in half a minute by 27¼ h. p. This heat can be maintained for any length of time, by means of a perfect controlling apparatus, the heat on the metal during that time remaining perfectly constant.

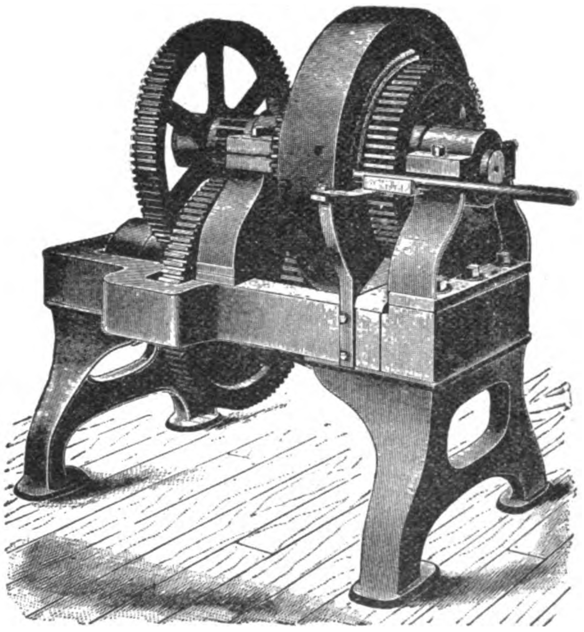


Fig. 4.—BURTON ELECTRIC ROLLING MACHINE.

A bar of machinery steel 1 inch square and 12 inches long is brought to a white heat in 2½ minutes by 36 h. p.

Among the claims for the Burton process, is, first, the economy of space, no provision having to be made for large furnaces, and consequently more room can be allotted to the metal-working machines. Then there is great economy in the fuel, as the fuel, instead of being scattered in a number of different forges, is concentrated in one boiler furnace. There are also no ashes to be withdrawn from forges, nor fuel to be brought to them, thereby affecting a large saving in time and labor. The simplicity of the machine is another factor in its favor, it being extremely easy to operate and under perfect control, and after a few pieces of metal of certain size have been heated, the machines can be set to act perfectly automatically and without any skilled assistance.

THE DAKE ENGINE AND THE DAKE HOIST.

For work calling for a direct attached engine, from one to 25 horse-power the Dake square piston engine, made by the Dake Engine Manufacturing Co., of Grand Haven, Mich., is becoming generally known. They are particularly compact and in a form that permits of economical application to any machinery. All that is required is to adapt the engine shaft to such machinery by coupling, or directly through the machine and bolt down. They are in many cases set in floors in the upper stories of high buildings. Fig. 1 represents, in general form and appearance, each of the five sizes of the stationary engines complete and in shape to attach steam and exhaust pipes and start.

Figs. 2 and 3 show the working parts of the engine. In Fig. 2 the pistons are removed, showing the interior of the case with crank in place. The crank revolves in the chamber behind the back of the interior of the case. This is supplied with oil and water from an opening on the back of the case just above the chamber, giving perfect lubrication to every part of the interior of the engine. Fig 3 shows the pistons in their proper position on the crank and carried to the extreme right hand side of the case. Both pistons, as will be seen, have a horizontal movement, sliding from side to side, and at the same time the inner piston, to which the crank pin is attached, has a vertical or up and-down movement, the two movements imparting a perfect rotary motion to the crank. The manner of applying the steam is by channels cast on the cover, one opening into a central aperture, and the other into an annular opening on the inside of the cover as shown in Figs. 2 and 3. Four channels are cored through the inner piston, one each leading to the top and bottom, and one to each end of the inner piston, the latter also leading through the ends of the outer piston. Four ports corresponding with the channels in the interior of the inner piston are cut through the face (or side next to the cover) of the inner piston in the proper position to register over the central aperture in the cover, the steam entering the port in the inner piston, through the central aperture of cover and resisting against the side of the case, imparts motion to the crank, the port passing over the annular ring and exhausting into it after having done its work. With the reversing engine the channeling on the cover and coreing of the piston is the same as in the engine built to run one way, but the ports in the inner piston are shaped so that they register over both the central and annular openings, using each alternately as steam and exhaust. The ports on the top of the case being fitted with a suitable valve which connects the channels leading to the working parts of the engine, motion is given to the engine either to the right or left as desired.

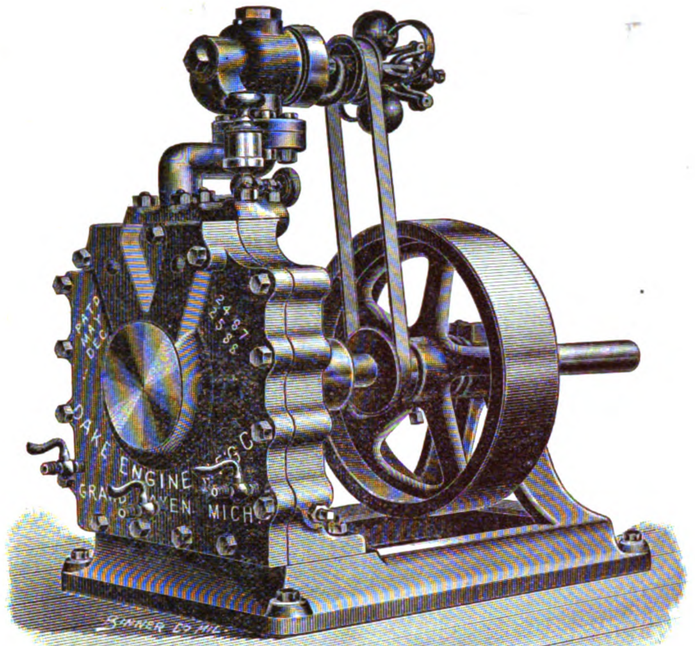

DAKE ENGINE MFG. CO. GRAND HAVEN, MICH.
BINNER ENG. CO. MIL.

FIG. 1.

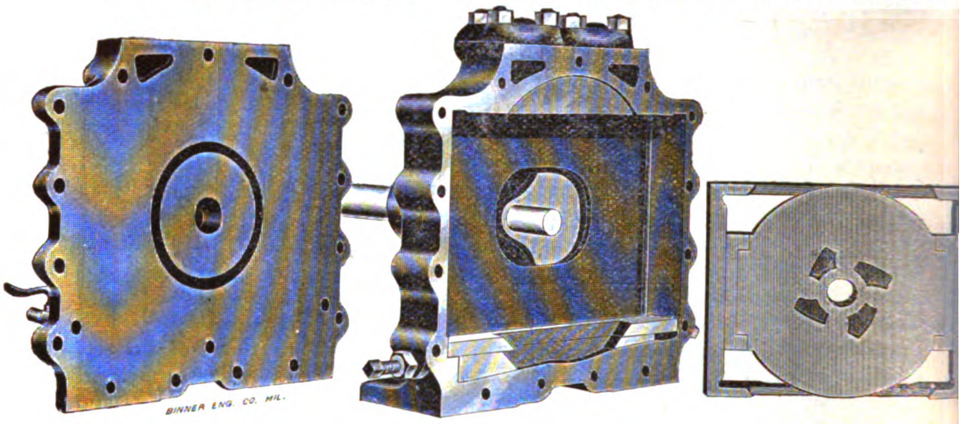
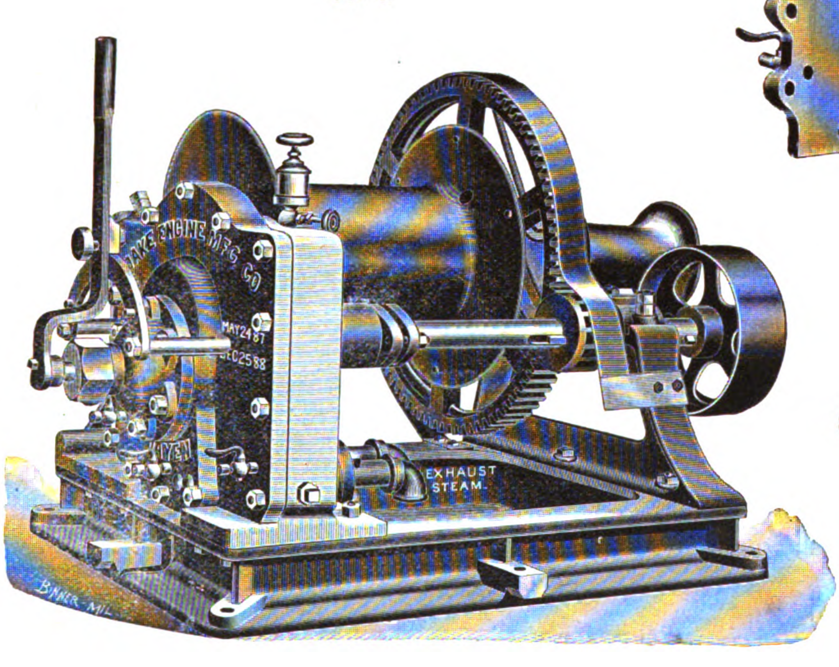

BINNER ENG. CO. MIL.

FIG. 2.


DAKE ENGINE MFG. CO.
EXHAUST
STEAM
BINNER MIL.

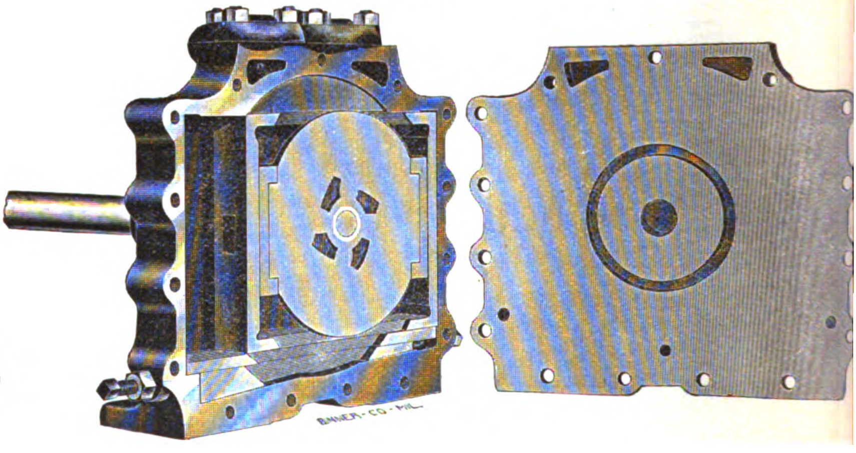

BINNER CO. MIL.

FIG. 4. THE DAKE ENGINE AND DAKE HOIST. FIG. 3.

The Dake square piston engine has been adopted by ventilating fan manufacturers and are well adapted for use with dynamos for electric lighting. The special claims for it are compactness, economy of steam, ease of application, small number of pieces forming the working parts, perfect lubrication and steady motion.

Fig. 4 shows the Dake marine, builders' and contractors' hoist, of which there are five sizes, ranging from 5 to 20 horse-power. They hoist, hold or lower the load entirely by steam, which is under control by one lever and movement, and the heaviest weight can be hoisted, held suspended, and lowered with perfect safety, either slowly or rapidly, as circumstances require.

Western Travel on the Nickel Plate.

Numerous letters of inquiry for information relative to rates and routes to the West, received at the General Ticket Office of the New York, Chicago & St. Louis Railroad, in Cleveland, O., indicates an increasing desire to seek homes in some of the new States recently admitted into the Union. With fully matured State governments, those of our people who contemplate a future home in the Great West, feel a greater confidence in investing than was felt under their uncertain futures as territorial governments.

North of Utah and south of the British Possessions the entire distance from the Atlantic to the Pacific oceans may be traversed within the boundaries of free and independent States of the American Union. In any of these west of the Great Lakes fertile farming lands may be secured at a nominal cost, and with the almost innumerable towns and cities which from year to year spring into opulent existence as if by magic, it is a matter of no surprise that many of our most energetic and ambitious citizens become restless and dissatisfied in our overcrowded communities, and aspire to enjoy the advantages offered not only to the agriculturist or stockman, but in almost any of the branches of industry which spring into successful existence wherever the plow point is, or the miner's pick lays bare the treasures of the earth.

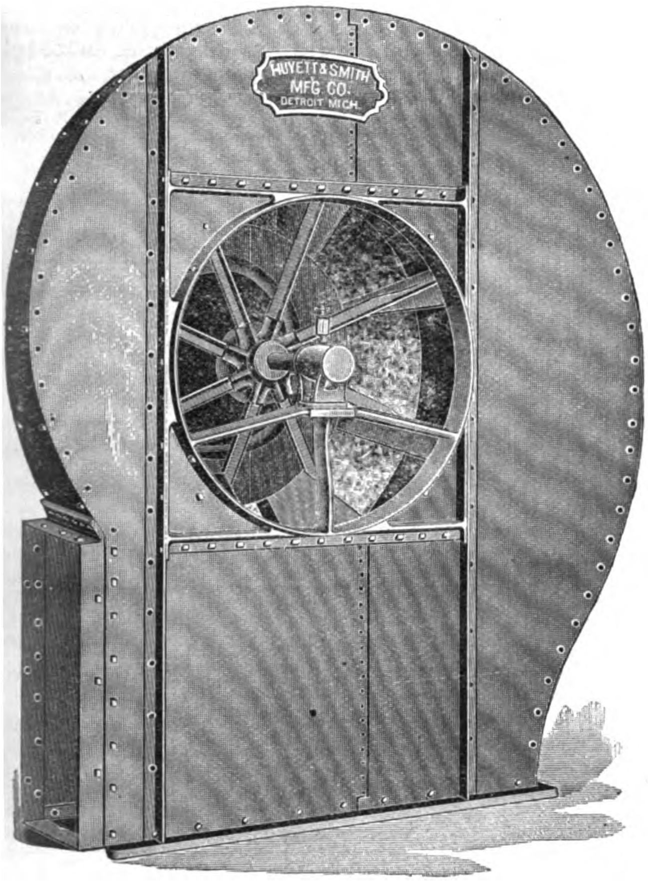
Special care has been taken to supply all ticket offices of the Nickel Plate with maps and printed information of interest to those contemplating a home in any part of the West, and also their facitities for ticketing passengers and checking baggage to any point in the United States, Canada or Mexico, are ample. If the information desired is not in possession of the agent when called for, the same will be procured at once, and by telegraph if necessary. Special advantages in rates may be secured at any time by consulting agents of the Nickel Plate.

Passenger Fares Reduced.

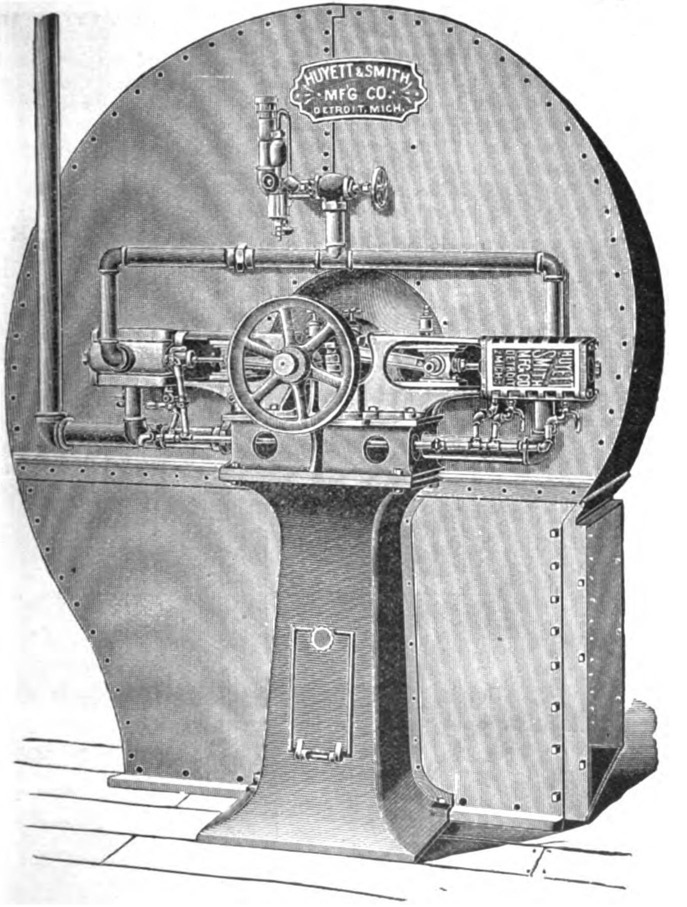
Frequent reductions in fares for the round trip seems to be the order of the day at present. In the Northwest or West, the news of the wonderful yield of cereals, or some recent development of the vast mineral wealth, sends a thrill to the feelings of the average citizen; or in the Southwest or South, some marvel of progress in the new industries so rapidly developing, calls strongly upon the speculative instincts.

Circulars and other information of all reductions are constantly in possession of the principal agents of the Nickel Plate. If inquiry is made of any agent of the Nickel Plate not fully informed on the subject, the information will be procured at once, and by telegraph if necessary. Tickets of any class on sale and baggage checked to any destination in the United States, Canada or Mexico, at lowest rates.

THE SMITH STEEL PLATE STEAM FAN.


HUYETT & SMITH
MFG CO.
DETROIT MICH.

A well-devised and particularly useful piece of mechanism for use in foundries, mines, vessels, etc., is illustrated in connection with this article. It is the Smith. steel plate steam fan with double direct attached horizontal high speed engines, designed and manufactured by the Huyett & Smith Manufacturing Co, Detroit, Mich. These fans have been extensively introduced during the past year and are a necessity where a large volume of air is needed to increase the combustion of fuel under boilers.

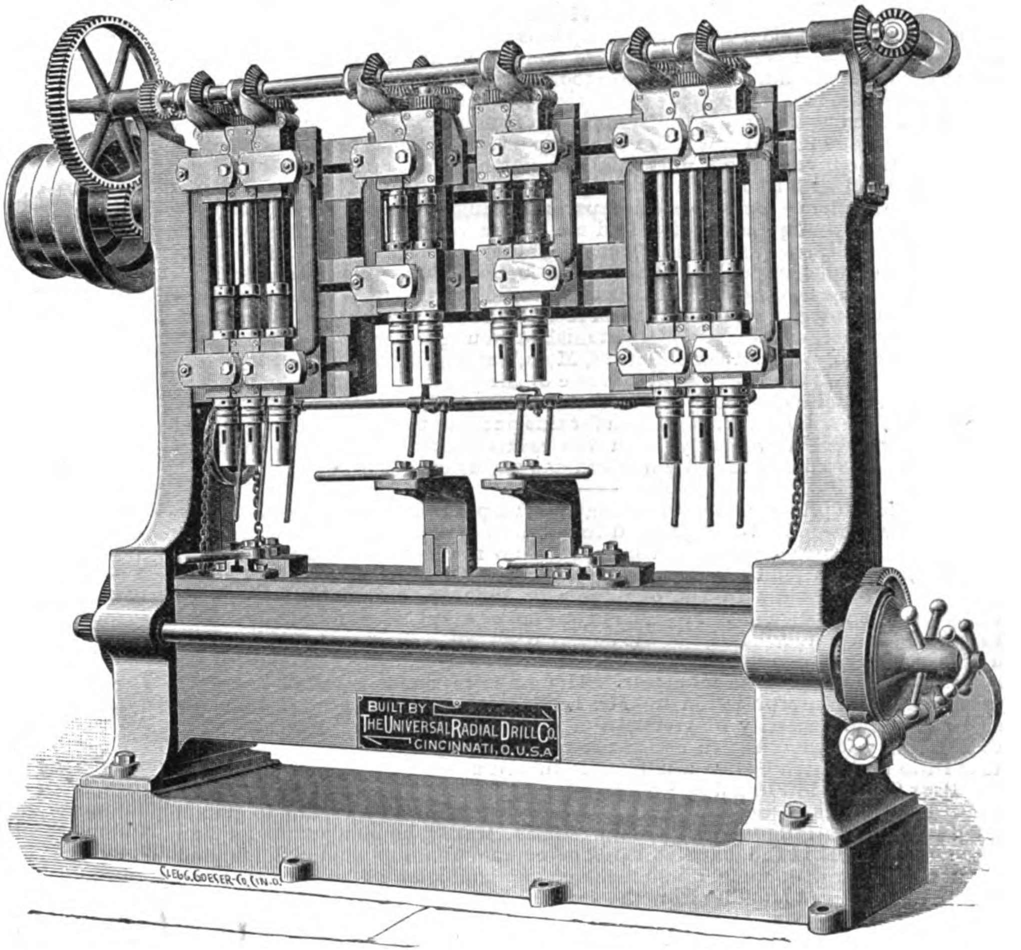

HUYETT & SMITH
MFG CO.
DETROIT. MICH.

The Smith steel plate steam fans are regularly made as exhaust fans, with the inlet on the opposite side from the engine, so as to avoid drawing the air across it, but where it is necessary to do so, they are built as blowers with an inlet on each side. These fans are built either right or left hand, and with or without engines. A right-hand fan has engine or pulley on right-hand side, looking in the direction the air is discharged, and the left-hand fan has the engine or pulley on the left-hand side.

The frame of these fans is of heavy angle iron, the casing of heavy sheet steel staid with T and angle beams, and the foundation is one solid cast plate, to which, as well as one side of the fan case, is attached the cast iron pedestal on which the engine or bearings for the fan shaft are secured. The wheels and fan shaft are of steel, all wheels are accurately balanced and thoroughly tested before leaving the works. The bearings are lined with the best anti-friction metal and provided with continuous oiling devices.

The engines are of neat design and finish, specially constructed for this purpose, with balanced piston valve, counterbalanced reciprocating parts, large bearings, perfect lubricating devices, including sight-feed lubricator, and are durable and economical to operate.

ARCH BAR DRILL.


BUILT BY
THE UNIVERSAL RADIAL DRILL CO.
CINCINNATI, O. U.S.A.
CLEV. G. GOESER-CO. CIN. O.

The Universal Radial Drill Co., of Cincinnati, manufacture the arch bar drill, an accurate presentment of which is shown in the illustration on this page. The cut shows a ten-spindle machine, but it can be furnished with six or eight spindles. All spindles are driven simultaneously by a three-step cone carrying a four-inch belt. The driving shaft is strongly geared. All spindles have a lateral adjustment without disturbing driving gears, and all spindles run in one direction, and can be closed up to drill to centres of four inches. The spindle sleeves are threaded outside and are adjustable vertically four inches, by means of lock nuts to compensate for differences in lengths of drills. Spindles are provided with vulcanized fibre thrust washers and check nuts for taking up wear of collars. The work table feeds upward by means of racks and pinions, belt driven, and has a quick return movement by hand, and is also counter-balanced. The feed table is provided with two saddle blocks, adjustable horizontally, and also two supports for the arch of car truck framed, and the latter are adjustable vertically to suit different heights; these saddles and supports have steel-faced back stops or jaws (the same being adjustable to suit different widths of arch bars) and the clamping is done by the four levers, shown, they being cam shaped and revolving about a steel bush stud. The cooling solution is piped to each spindle from one reservoir. Weight about 11,000 pounds.

A Columbian Fair Memorial Building.

Mr. Baker proposes a total expenditure of $1,000,000 for the building, and daeclares tht if this were furnished, there would be forthcoming contributions of specimens and articles of historic interest aggregating $3,000,000 in value, The whole State of Illinois ought to unite in subscribing the million desired. for the museum will be an incalculable benefit to the State as well as one of its proudest possessions. Philadelphia rejoices to-day in the possession of two beautiful memorials of her Exposition—Horticultural Hall and Memorial Hall, both situated in Fairmount Park, and both containing collections which are among the largest and finest of their kind in the country. Nothing would induce her to part with these, to have their beneficent influence eliminated from the community. The city and State contributed through large appropriations to the erection of these institutions, nearly two millions of dollars going into the construction of them, but the outlay has never been regretted. It will be all the greater honor to Chicago and Illinois if they can erect their memorial by private aid alone.—[March Century's "Topics of the Time."

The Midland Railway Co., of England, are trying the experiment of warming their cars by means of hot water from the boiler of the locomotive, the arrangement being in operation upon the express trains. The contrivance is a simple one, and so far seems to have met with success. The pipes pass through each of the compartments in the train; the driver has control of the apparatus, and so regulates the process as to produce the required heat, and the pipes, when not in use, are emptied, thus preventing their freezing in severe weather.

A SET OF FINE TOOLS.

BY WM. HARRISON.

[Let not the reader whose taste does not run to that which diverts as well as instructs the minds, and who shuns fiction as unprofitable stuff, think that he will violate his custom by perusing Mr. Harrison's paper. It is essentially true, and those who skip it will miss a narrative that substantiates the saying that "Truth is stranger than fiction."—ED.]

RECAPITULATION.

Charles C. Adams, a mechanical engineer and instructor in a technical school, is reduced by sickness and his bad financial management, to distress. While in these straitened circumstances, a gentlemen, calling himself John W. Ellis, visited him and gave him employment. The work was to make from certain drawings a set of tools, which, Mr. Ellis explained, were to be used in constructing the model of a very important invention. There was to be absolute secrecy. Five hundred dollars were paid down, and as much more when the work was finished. The job took about a week. Ellis set the price himself, and the reasons he gave for paying so much satisfied the maker.

Mr. Adams now had not only sufficient funds to relieve the distress of himself and parents, but was able to develop an invention of his own. He was a most prolific inventor, but only this one patent was commercially valuable. He went ahead with it and in a short time became wealthy. The strain of providing a competence for himself and parents being now eased, he devoted his attention to a young lady, Miss Ludlow, whose hand he asked in marriage. The lady herself was quite willing, but the father was in no haste to accord his consent. On the occasion of the interview between Mr. Adams and Mr. Ludlow, on the subject, which it was expected would be final, the latter produced a pair of long forceps, which had been left behind by a burglar who raided a neighbor's house, and showed the astonished young inventor and manufacturer the name of "C. C. Adams, Detroit, Mich," stamped in the steel. There was no doubt that the instrument was one of the set made for the alleged purpose of constructing a model, nor that Mr. Adams had, instead of handing the blacksmith the stamps furnished him for this purpose by Mr. Ellis, substituted his own for them unwittingly, with the result that his name was on every piece of a large kit of unusually fine and dangerous burglars' tools.

The change produced by the passage from a panoramic representation of a semi-tropical scene in Springtime directly into a midnight and midwinter blizzard in the open street, could have been no more sudden than the transition from peaceful and blessed anticipation to the untold horrors of nightmare which followed, with the quickness of thought, the realization of this unfortunate circumstance. Mr. Adams was never adept at improvising works to hold back a sudden charge of the enemy from an unexpected quarter until a proper defense could be made. He was, therefore, bereft of speech and almost of reason for some moments. His embarrassment was not given the most charitable interpretation by Mr. Ludlow, who requested Mr. Adams to spare them the necessity of giving him the "cold shoulder" until he could explain away to their entire satisfaction the damaging testimony offered by that little tool which had so accidentally turned up.

Poor Charley left in a fit of combined chagrin, rage and astonishment. He walked four miles before his mind reached a state of composure to give it qualification for independent action. When, finally, he reached home and secreted himself in the barn to think over the calamity that had dropped down upon him with meteoric suddenness, he could see no better way to do than to tell Mr. and Miss Ludlow the exact truth. He could show the name stamps that were given to him, the one's he erroneously sent the blacksmith having been handed back to Mr. Ellis, in support of his story.

At last he decided to submit the case from Ludlow's standpoint, as one suppositious, to a friend who used to lecture at the school, but, who was now a civil engineer, and hear from him what he would think of the explanation he could make. Therefore he carefully wrote out the facts of the unlucky incident as Mr. Ludlow would relate them, and added the answer that he had decided to make—the plain truth. He did not fail to mention the good standing and the former poverty of the party, who was thus brought forth for judgment. Mr. Laertes Ward, a man of balanced mind, deliberate in arriving at a conclusion and swayed by no prejudices of any sort, was a model judge. Surely, his decision would, in no ordinary degree, reflect the probable opinion of the more intelligent classes and be as lenient with the youth as the circumstances would warrant.

He sent it to Mr. Ward at once, and asked him to return a written decision the next day.

Had this gentleman been the wearer of Supreme Court ermine he could not have prepared a more careful, scholastic and dignified document than was returned to Mr. Adams. We can not go through the one hundred pages of foolscap, which the answer covered. He decided against the young man and committed him to the penitentiary for 10 years. The reasons for so doing, condensed from the great mass of that finely drawn argument, were that a gentleman of the intelligence of the respondent could not be exonerated from the charge of knowing that the tools were for an evil purpose. Had he not been himself an inventor, there might be pleaded for him ignorance of the methods employed to build models, to palliate the complicity and point to the possible innocence of his motive. The exorbitant price paid for the work was another count that the explanation did not clear up. The defense that to put one's name on tools which were known to be for burglar's use would be too fool-hardy to credit to a sane person, did not go far with him. No one could make instruments of crime for another without placing himself in the power of that person, to some extent. One who would lecture to students in the day time for one dollar per hour and make suspicious tools at night for over ten dollars per hour would be just the man to break the record in acts of supreme nerve by imprinting his name in those instruments to protect himself from infidelity of accomplices, believing that the public would acquit him of the charge of knowing that certain implements he had voluntarily forged his imprint on were for depredation on society. The very effrontery, he probably thought, might carry him through.

Mr. Adams' composure was not heightened by this deliverance. If Mr. Ludlow took the same view of his friend Ward, he had little to hope in that direction.

Miss Ludlow was nearly distracted when she heard of Charlie's misfortune and discomfiture. She took no stock in his complicity in any shady operations, and rained tears of indignation when her father expressed a different opinion.

The next month was a very long one for our hero. He had not succeeded in impressing Mr. Ludlow with the truth of his story and explanation. And to make matters worse, that gentleman was seriously contemplating an interview with the police in regard to the matter.

He was in the greatest misery and perturbation, night and day. His income kept on increasing rapidly; yet he would have given every dollar he owned if he could but hold in his hands those apparently harmless scientific instruments, each one of which might plunge him into a maelstrom of vexation and trouble. Yet no one but the Ludlows knew of his dilemma.

He was getting too nervous to be alone much, and to drive away the demon of fear that haunted him, he made up his mind to re-enter society. He was much sought, and invitations to the best houses were plenteous. One Saturday evening he attended a party at the Brunswick's, in the suburbs. The Brunswicks were conspicuous in society, in which they held a very important place. Mrs. Brunswick took special pains to make herself agreeable to Mr. Adams. She was a great admirer of inventors, and would he not allow her to make him acquainted with Mr. Sylvanus V. Ashton, a brilliant young man lately from college, who was perfecting what they all hoped would turn out a great invention? Mr. Ashton, by the way, was, so Mr. Adams had heard, a great favorite at the Brunswick house and was likely to ally himself with it before long. Of course Mr. Adams was anxious to meet this genius, and when he held out his hand to Mr. Sylvanus V. Ashton he was incinerated, he thought, by what seemed like a shock from a 2,000-volt current, for the promising young inventor who was about to marry one of the wealthiest girls in Detroit was none other than John W. Ellis, the owner of the set of fine tools which had made his fortune and now threatened to wreck it again.

(To be continued.)

ELECTRIC CRANES AT THE GRANT LOCOMOTIVE WORKS.

[See first page.]

One of the most interesting of the recent electrical installations is that of the great electrical cranes and lighting plant at the Grant Locomotive Works which are now being fitted up in Chicago. The crane in the erecting shop, a view of which is given in Fig. 1, is of 40 tons capacity, and is equipped with five motors. The hoisting equipment on this crane is double, and consists of two motors each of 12 horse-power capacity. For traveling, a single 8 horse-power motor is used, and for traversing two motors of 4 horse-power each. The crane girder is six feet in depth, and has a very large span, the distance between rails being 78 feet, while the travel of the crane is 400 feet. This crane is to be used for moving very heavy pieces from one portion of the shop to another, and is capable of lifting a locomotive off its wheels, and transferring it to a new position in the shop.

The crane in the boiler shop is of 20 tons capacity, and is provided with three motors—one 12 horse-power for hoisting, one 8 horse-power for traveling, and one 4 horse-power for traversing. The travel of this crane is 247 feet, and the span 57½ feet. The crane in the foundry is of 20 tons' capacity, and is provided with three motors—one of 8 horse-power for hoisting, one of 6 horse-power for traveling, and one of 2 horse-power for traversing. The span of this crane is 50 feet, and the travel 263 feet.

But one of the four cranes has thus far done any actual work. This is the one installed in the machine shop, which has proved very useful in lifting heavy machinery from flat cars on the track running through the building and placing it in position. The crane is of 10 tons' capacity, and is provided with three motors, one of 8 horse-power for hoisting, one of 6 horse-power for traveling and one of 2 horse-power for traversing. The span of this crane is 64 feet and the travel 260 feet. Interesting details of construction are shown in Figs. 2 and 3. The former picture gives a good view of the traversing carriage mounted on the crane. This carries the 8 horse-power hoisting motor and the 2 horse-power machine by which it is itself moved. The main trolleys and the 6 horse-power motor furnishing power for moving the whole crane are plainly seen. Under each crane on the trolley side hangs the operator's cage, from which the movement of the crane is controlled. The current for the motors on the traveling crane is taken from overhead trolley wires, Fig. 3, which are suspended from the iron truss rods of the roof by means of insulating bells. The illustrations are from the *Western Electrician*.

Go to the New South.

Excursion Thursday, April 11th, 1892, via Queen & Crescent Route to Harriman, Tenn., 255 miles south of Cincinnati. One fare for the round trip. Tickets good 30 days for return. Train leaves Detroit at 9 20 P. M.; Toledo, 11.40 P. M.

Harriman is the most substantial and marvelous of many new Southern towns. On April 12th, 13th and 14th, the East Tennessee Land Co. will have their second auction sale of lots at Harriman, nearly all the proceeds of which go to improve the city in aiding manufacturing interests, etc.

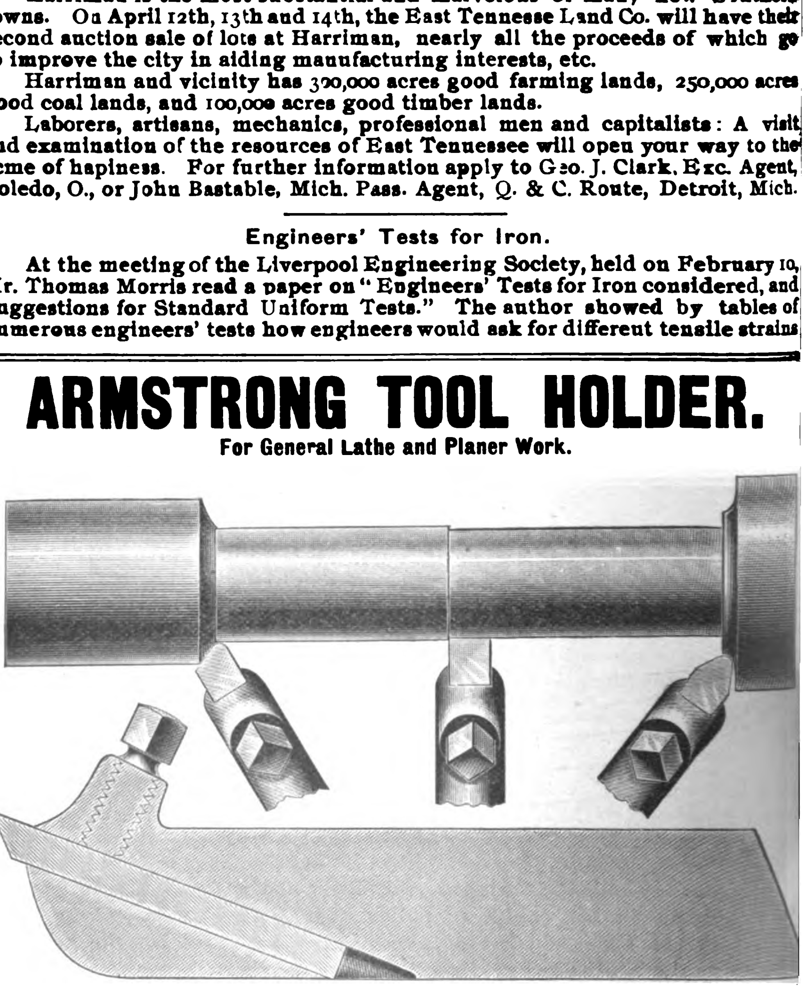
Harriman and vicinity has 300,000 acres good farming lands, 250,000 acres good coal lands, and 100,000 acres good timber lands.

Laborers, artisans, mechanics, professional men and capitalists: A visit and examination of the resources of East Tennessee will open your way to the acme of hapiness. For further information apply to Geo. J. Clark, Exc. Agent, Toledo, O., or John Bastable, Mich. Pass. Agent, Q. & C. Route, Detroit, Mich.

Engineers' Tests for Iron.

At the meeting of the Liverpool Engineering Society, held on February 10, Mr. Thomas Morris read a paper on "Engineers' Tests for Iron considered, and Suggestions for Standard Uniform Tests." The author showed by tables of numerous engineers' tests how engineers would ask for different tensile strains

ARMSTRONG TOOL HOLDER.
For General Lathe and Planer Work.



A PRACTICAL SUBSTITUTE FOR FORGED TOOLS.
Especially adapted for the economical use of Self-Hardening Steel. Tools sent on tria, which, if not satisfactory, may be returned to us at our expense.
MANUFACTURED ONLY BY
ARMSTRONG BROS. TOOL CO., 78 Edgewood Ave. Chicago, Ill.
Mention this paper. Send for Circular.

same class of work, adding that the iron must be equal to some known rand," as though the iron produced in the localities named were uniform in ulity. He paid a high tribute to the reduction of area test, as being one t gave more consolation to the engineer in case of work coming to grief n any other test specified. The elongation test, which he said was only other form of test for ductility, was not to be depended upon with the same e and comfort as contraction of area; and the manner in which the former t was specified by nearly all engineers was anything but creditable. He ated the limit of elasticity test with disfavor. His suggestions for standard form tests and conditions were put in the simplest form, and were thoroghly explained to those present. The paper was very well received by the ge number of members present, and the discussion was adjourned to the t meeting.—[Iron and Coal Trades Review, London.

New Iron Clad Destroyer.

General Gordon's design for a new ironclad destroyer is under consideron by the Naval Committee of the House of Representatives at Washington. e vessel is to be 260 feet in length by 40 feet in breadth and 16 feet draft, ing a displacement of 2,400 tons, with a speed of 20 knots an hour. The sel in size will be larger than the Yorktown and smaller than the Charles-. The feature of the design is found in an enormous submarine gun ried at the bow, below the water line, and a hydraulic buffer projects from bows. This is so adjusted that it will stop the boat at a distance of 8 feet n the enemy's ship, without injury to the boat. At this short range the fer automatically discharges the submarine gun directly at the hull of the o, and lodges within it a shell carrying a bursting charge of 450 pounds of wder, sufficient to blow down every bulkhead in the ship and wreck the tom. The details of the boat, it is said, have been carefully worked out, the calculations have been verified by experts.

British Ship Building in 1891.

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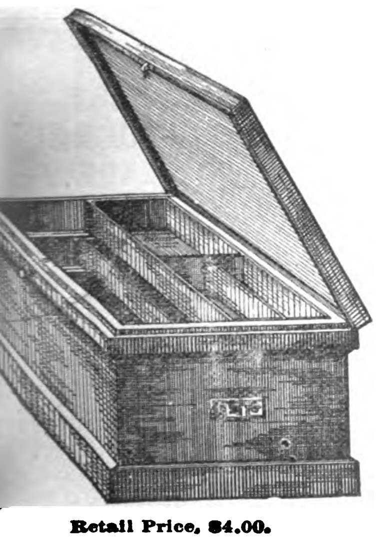

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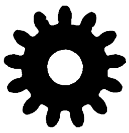

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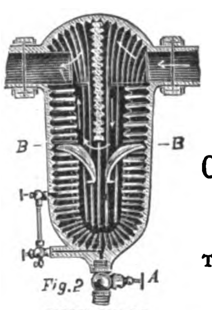

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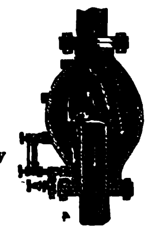

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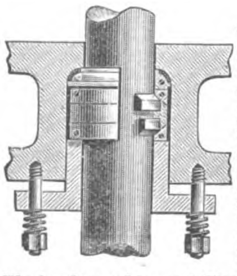

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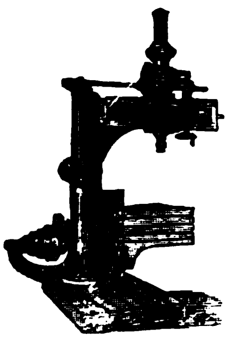

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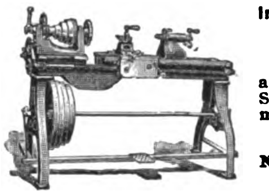

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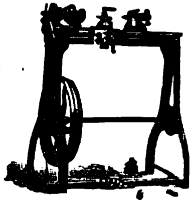

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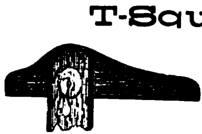

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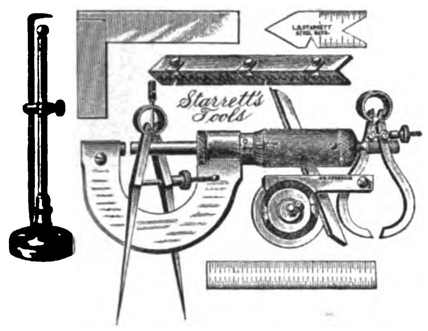

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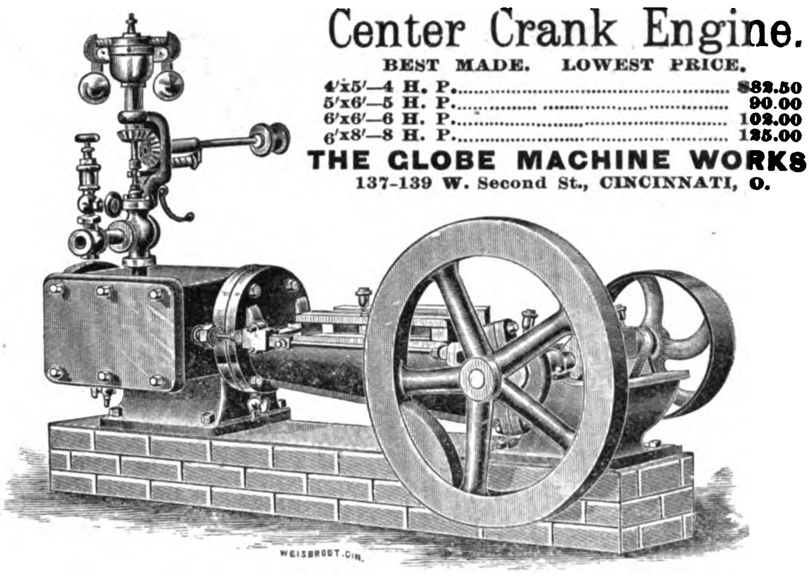
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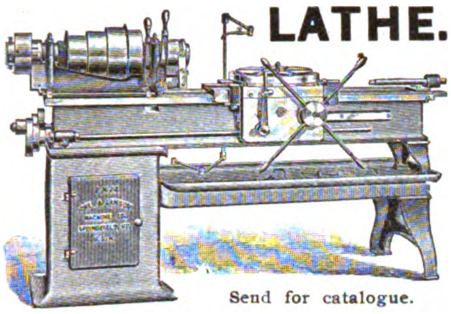

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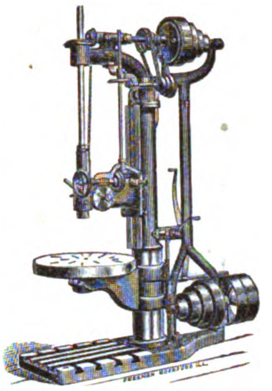

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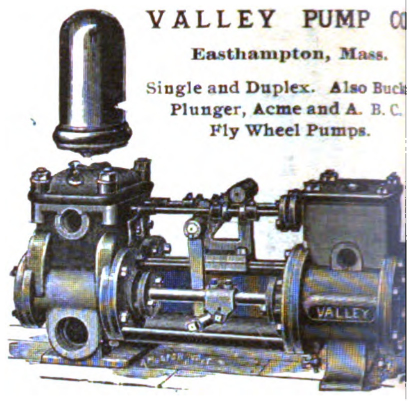

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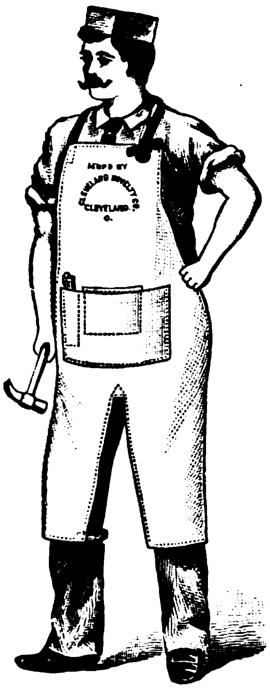

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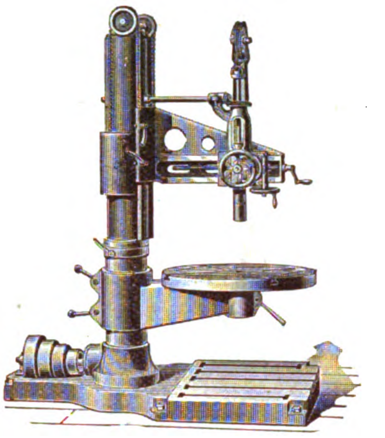

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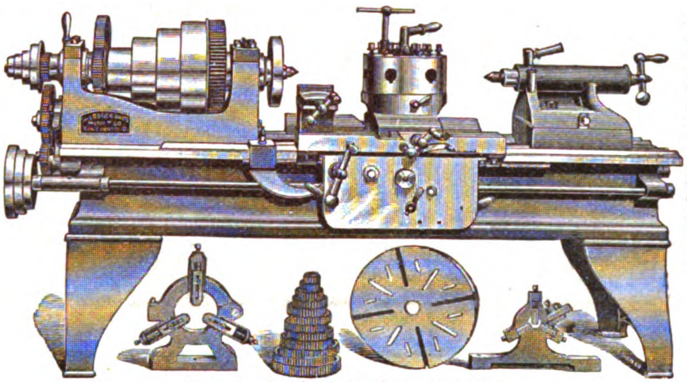

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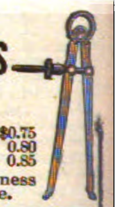

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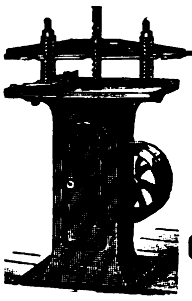

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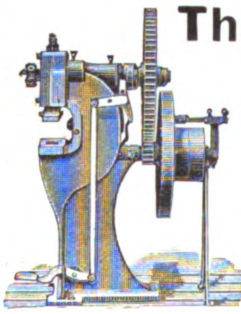

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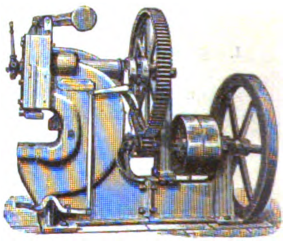

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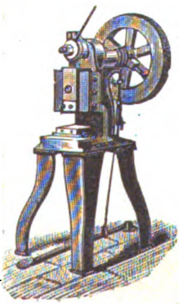

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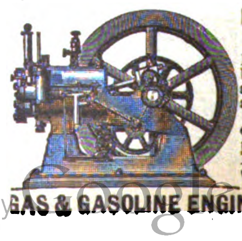

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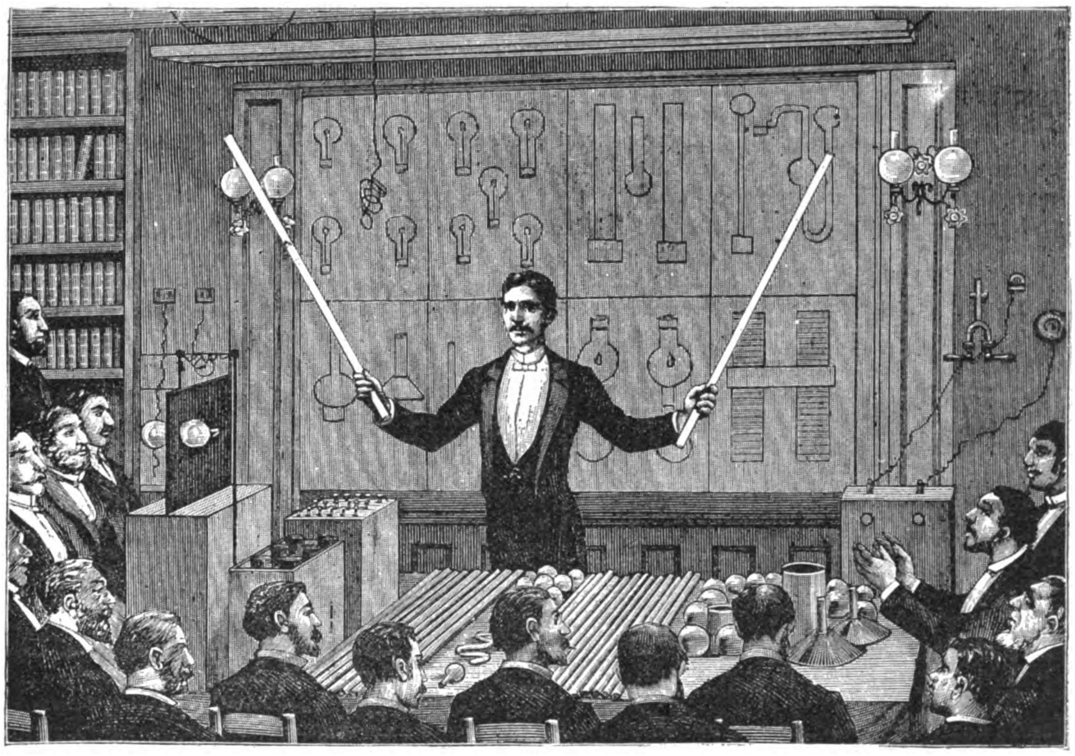
NIKOLA TESLA, THE FAMOUS AMERICAN ELECTRICIAN.

About a year ago the interest of the scientific world was aroused as it seldom is, by a lecture delivered by Nikola Tesla, a young man who had been been studying electricity with George Westinghouse, the inventor. Mr. Tesla showed how he had created electric illumination by induction. The incandescent lamp was made to glow without connection with wires, and could be moved about anywhere, within the electrified area, or circuit. Since then he has become known to electrical and scientific men as a great discoverer. While the masses are not familiar with his name, the fact that electric journals class him with Edison, Thomson and Brush, indicates the reputation he has attained.

The illustration, from the *Western Electrician*, on this page, represents Mr. Tesla lecturing before a select scientific audience in France. The above journal says:

"Nikola Tesla has made a profound impression abroad, and the lectures which he delivered in England and France, last month, were received with positive enthusiasm. In the latter country the reception was naturally of a more demonstrative character, and one of the French scientific journals in a frontispiece fairly represents Mr. Tesla as a prestidigitateur. The illustration is presented herewith. The engraving is supposed to illustrate the joint meeting of the Societe de Physique and the Societe Internationale des Electriciens, which was held on February 20th. To quote from the journal in question: 'The young savant is as thoroughly convinced as a forerunner, almost, we might say, as an apostle. There is so much enthusiasm and sincerity in his explanations and experiments, that faith is born within one, and he believes he is present at the dawn of a revolution in artificial means of illumination. * * * The warm plaudits that his lectures have received in England and France prove that he has excited the enthusiasm, if not the conviction, of those men who are most capable to appreciate the grandeur and importance of his work. For the skillful experimenter we wish all success in the new field in which he is engaged. We trust that when next he comes to Europe the light of the future will have become the light of the present.' When his work excites such rapturous comments as this, and when he is regarded almost as a magician, Mr. Tesla must regard his trip abroad as decidedly successful.


NIKOLA TESLA LECTURING IN FRANCE.

"While Americans do not perhaps indulge in such high-sounding phrases, they none the less appreciate the marvelous work that Mr. Tesla has accomplished, and are no less ready to give him the hearty and enthusiastic praise that he deserves. His lectures abroad are not merely repetitions of his paper before the American Institute of Electrical Engineers, but are important developments of that remarkable production."

HOW TO FIRE A BOILER.

On February 27, a paper was read before the National Electric Light Association, in convention at Buffalo, by R. Hammond, on firing boilers, of which the following is a synopsis:

It has been said that the waste of fuel due to improper firing is often of more consequence than any other loss which is produced in the operation of a steam plant, but in a great many cases the waste of fuel cannot be entirely charged to improper firing, as there are other causes by which a waste of the evaporating power of the fuel is produced. Among these is the improper construction of the boiler in relation to grate surface, tube area, heating surface and combustion chambers. Unless these proportions are properly worked out, waste of fuel must necessarily follow. A great many contrivances have been placed on the market, such as mechanical stokers and other means by which coal and air can be supplied to the furnaces of steam boilers for the purpose of obtaining good combustion without producing a waste of heat, by allowing too much air to pass above the grates, or an insufficient supply below the grates. By this statement I do not mean that any particular method of firing will produce any more heat from a pound of coal than nature put into it. Just as good results can be obtained from hand firing as have been obtained by the best mechanical means. We should be as particular to have good firemen in charge of our boilers as we are in having good engineers in charge of our engines. A good fireman should be just as capable of manipulating the furnaces of his boiler so that his steam recorder and his coal and water records will show just as good cards as the engineer can show in the manipulation of the steam he uses in his engine. If we paid the same attention to all the details of the construction and setting of our boilers and their economical use of fuel as we do to our engines our steam plant would be far more economical. Everything is "shined up" about the engine. Engineers go into all the details of its construction and management, and the greatest care is taken in the figuring out of its proportions so that it will have the very highest possible initial steam pressure and temperature, and the very lowest possible terminal temperature and pressure; all endeavoring to get the greatest horsepower from the pound of coal, thus securing the greatest economy. These very same highly educated individuals, who designed these engines, forget that all the power comes from the pound of coal, and pay little attention to how that power is transmitted from the coal pile to the engine. It is just as essential to good economy that the boilers should have the very highest initial or furnace temperature, and the highest possible steam pressure and the lowest possible chimney temperature, as it is for the engine to be economical under similar conditions of high initial pressure and temperature and low terminal temperature.

Bituminous coal requires 150 cubic feet of air per pound of coal for good combustion. An excess of air results in a waste of heat which it carries into flues and chtmney, and often a greater loss in an insufficient supply to produce good combustion. For steam plant boilers carrying 80 to 160 pounds of steam, at least 20 pounds of bituminous coal should be burned per square foot of grate per hour, and the air spaces of the grates should not be less than 50 per cent. of the grate area, and the draught pressure not less than 2½ inches of water. Steam users should see to it that all parts of their boilers and settings are of equally good proportions for strength and economy as their engines, employ good, intelligent firemen as well as engineers, and see that both produce good indicator cards. By a little attention steam users will gain much experience.

A Large Power Dam.

The largest power dam yet built in this country will be that now in progress of construction across the Colorado River, at Austin, Tex. It will be, when completed, 1,150 feet long, 60 feet high, and 18 wide at the top. The up-stream face is of limestone, and is vertical, while the down-stream face is of Texas granite, and the interior of rubble masonry of small stone and cement. There will be about 9,000 cubic yards of granite, 6,800 cubic yards of limestone and 55,000 cubic yards of rubble in the dam. The dam is intended to utilize the power of the Colorado River for electric lighting, electric railways, pumping the city's water, and for factories, etc.

Electrical

Some Applications of Electric Heating.

The following paper was read before the Chicago Electric Association, March 8, 1892, by R. W. Larrabee:

Electric heating, by which I mean the heating of cars and houses by the electric current is, in its development, about ten years behind electric lighting. Ten years ago the new incandescent light had just begun to win the confidence of the public. It had to contend with all sorts of difficulties and of the thousand and one objections which the wise heads brought against it, the greater part were quite imaginary. Prejudice and ignorance fought hard against the new light, but they are completely routed now, and the question of economy is the only one which we hear raised when the adoption of electricity is proposed.

Electric heating has been struggling to bring itself before the public for nearly thirty years and doubtless would still be quite experimental had not the inventions in electric lighting apparatus of the last few years called attention to the fact that the dynamo could be used as a source of heat as well as of light. When we consider that nearly 90 per cent. of the energy of the electric lamp is wasted in heat, it seems odd that light should have come first. First in the field it was, however, and so occupied the whole field, that until quite recently, we have not heard much of electric heating. Various forms of heating apparatus are now on the market, and ten years from now we shall probably see them as commonly adopted and as high in public favor as is the incandescent lamp.

Much can be said in favor of a change from wood, coal or oil stoves to electric heaters, as a moment's consideration of the importance and scope of this branch of electrics will show. Consider how largely we depend upon artificial heat for the necessities of life. Take the fire from the kitchen, laundry and furnace-room, and we might as well die at once. Life would have very few charms for us, surely, and what trouble we go to and what an amount of inconvenience and annoyance we put up with, all for the sake of heat. Smoke, noise, dust, smell and hard work go with every stove. These items are not put down in the bill, but they belong to the stove, and they "stay with her" from the first coal put in the grate until she breaks a leg or burns your house down.

Now is all this annoyance worth while? Certainly not if it can be avoided, as it certainly can be. Electricity will do it. Electricity will heat a curling iron for the hair dresser, to begin with little things, a flat iron for the laundress, a soldering iron for the tinsmith and a weld for the blacksmith. It will heat a warming pan, a chafing dish or a cook stove. It will warm a street car or a whole house, and if there is any other purpose under heavens except a conflagration, for which the heat of a gas, coal or oil flame is used, the same result is accomplished more easily, more conveniently, more clearly, more æsthetically every time by electricity, though not always more cheaply Let us except, however, from this sweeping assertion the cheerful grate fire. This is a bit of nature let loose in a room which is inimitable and without a rival.

A detailed account and description of the many applications of electric heating would be tedious, I will therefore notice only the car heater and the house heater. First, car heater. What are they like? How are they constructed? What do they cost? In appearance the most common form of car heater is an elongated, rectangular waffle iron on four legs. It is 27" long, 8" wide and stands 4" from the floor. It is formed of two deeply corrugated cast iron plates which hold between them, as in a box, a mass of fire-clay in which are embedded coils of german silver wire. The fire-clay prevents, in some measure, the oxidation or the wire, and the deep grooves of the surfaces of the heater afford extra radiating surface. An early form of the heater combined coils of No. 28 platinum wire and bars of copper in alternation. The copper was very much heated by contact with the coils, and formed the radiating surface of the heater. This form is not now in use.

Those first described, taking up but little space, can easily be placed under the seats of the car, two on each side for an ordinary street car. The spaces made to receive them are lined with zinc or tin, and so shaped that almost all the heat is thrown out into the car, and does not get lost under the seats. A switch placed conveniently for the conductor, enables him to run the heaters in parallel or in series, as he may desire, in parallel at first, for 20 or 30 minutes, in order to heat them more quickly, after that, in series, to maintain a constant heat. Users are warned against the parallel arrangement for longer than half an hour lest the wires get red and oxidize and finally burn out, still these heaters have been run for something over an hour without apparent danger. With ordinary care I can see no reason why they should not very much outlive the cars in which they are placed.

To operate these heaters a constant current of three amperes at about 500 volts is required, that is about two electrical horse-power. From these figures of work, some very interesting and unexpected figures of cost are deduced. Here is a statement given by the company whose apparatus I have described:

2 horse-power per set of four heaters.
4 pounds of coal per horse-power hour.
144 pounds of coal per 18 hour car day.
Cost of coal $1.75 per ton.
1 pound of coal $.000875.
144 pounds of coal $ 12528 (should be $ 126).
Cost per car day $ 12¾.
Stoves cost in this case $.25 per car day.

Here is another set of figures identical with the above except the coal cost $3.75 per ton, and a car day is 10 hours instead of 18, bringing the cost of the heaters to 15 cents per car day, when stoves cost 35 cents.

2 horse-power per set of four heaters.
4 pounds of coal per horse-power hour.
80 pounds of coal per 10-hour car day.
Cost of coal $3.75 per ton.
1 pound of coal $.001875.
80 pounds of coal $.15.
Cost per car day $.15.
Cost of stove in this case $.35.

These figures, it is claimed, are taken from two roads using these heaters which I have described.

In view of the fact that Mr. Edison is reported to have said that electric heating could not be profitable, as its cost, compared to other methods in use, was nearly as 9 to 1, and in view of the further fact that Messrs. Crosby & Bell, in their recent publication on the electric railway, gave the comparative costs of 72 cents per car day by electric heater, and 10 cents by stoves, the above deductions are startling to say the least.

Even allowing for the error in assuming that a horse-power in a boiler means a horse-power in the dynamo to which it is supplying power, and a horse-power anywhere on a long line, there still remains a very large discrepancy. The advertising circular says 15 to 25 in favor of electricity. The latest scientific authorities say 72 to 10 in favor of stoves. Personal equations in mathematics are sometimes very peculiar, but this one of the advertising circular is the most disturbing element I have ever met in a calculation. Enthusiasm is a great thing.

Another form of car heater is an iron mat placed on the car floor, protected from the feet of the passengers by wooden cleats. This is certainly a convenient form and one which would put the heat just where it was wanted, but I doubt if the drippings from umbrellas and shoes in wet weather would not envelop the passengers in steam and introduce, also, a discordant note into the harmony of smells which is apt to pervade the average street car. Whether or not this apparatus is in use anywhere I do not know. I believe it has been patented.

The advantage claimed for electrical heating are: convenience, economy of labor, cleanliness, regulation of heat, safety, no danger to cars, economy of cost.

These claims, except the last, are, it seems to me, fully warranted by the facts. Consider them in order. How much more convenient for the conductor to regulate, if necessary, the temperature of the car by merely throwing a switch on the platform, than to shake down and feed a stove with coals, either from inside the cars, or, as on our west side lines, from the outside. What a saving of labor and of time! No coal to be brought, no ashes, no bother. Then there is the absolute cleanliness, and absence of smell, smoke and soot. That the heat is always on top, for as long or as short a time as may be needed, is another good point. In Spring and Fall there are many days when heat is not needed all day long, but when ordinarily a fire is kept in the stove throughout the day that a new one need not be kindled. Right here the electric heater scores one on the ground of regulation and economy.

The next point, safety, is a more important consideration on rapidly moving trains than on street cars. Street cars are occasionally burned on the track, but the lethargic inhabitants of Philadelphia or even St. Louis could escape with their lives in the event of such a catastrophe. This claim, with the next "no damage to cars," will appeal to the street car companies more than to the public.

As to the last point, economy, there is no doubt that stoves are cheaper, but so are tallow dips cheaper than electric light.

All of the advantages claimed for electric car heaters can also be claimed for house-heating apparatus, and as at present made, both are identical in appearance, though the latter heater admits of many variations. In this field, however, the electric heater has to contend with steam, a much more formidable rival in point of cost than the car stove. For example, one horse-power of a boiler will heat 40,000 cubic feet of space. One electrical horse-power, it is claimed (which, by the way, means more than one horse-power of a boiler, say 1⅙ horse-power) will heat only 3,000 cubic feet of space, so that the ratio is about 1 to 15 in favor of the steam radiator.

These are heavy odds, but the friends of the electric heater book them smilingly. The confidence of these enthusiasts is amazing until one of them has talked to you for awhile, and then you begin to understand their point of view. I shall not attempt to tell all that one of these gentlemen might say to you on the subject of stoves, but if there is any vice to which any stove was ever addicted he knows it and tells it. There is scarcely a crime in the calendar which a stove has not either directly or indirectly committed. It is a villain at heart and all its life practices nothing but meanness and deceit. It burns holes in your carpets, ruins books and furniture with dust, befouls the air with gas, fills the house with smoke, gets red hot in the middle of the night, and puts out the fire in the morning in time for you to get up and build another. These and a thousand other evils you hear until truly you are ashamed to own that you have even slept in the same house with a stove, and if you should meet your own family stove coming down the street, you would cut it dead.

But a furnace, you say—My dear sir, worse and more of it! What is a furnace but a big stove with special service pipes called flues to every room, to spread colds, headaches, throat trouble and what not from top to

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Mention this paper

bottom of the house. The register is well named. It registers every time the furnace door is opened, every shovelful of coal that goes into said door and every shaking and poking that the big stove needs to keep it alive. The house maid's giggle and her company's guffaw are duly registered up stairs, and as for odors, it is registration day in kitchen and laundry all the year round.

He has not so much to say against steam; he will admit that, for your money, it is a good way to get warm, very warm indeed. Some nervous people object to being wakened by artillery practice close to their heads every morning; for his part, he is an old soldier, and rather likes it. He likes, too, the curious habit some radiators have of flooding the carpet in the night, it reminds him of rainy days in camp, but it does provoke him to have the man who lives in the room below come up and complain as if he (the old soldier) had caused the flood.

And so he rattles on, and you think you may as well give up trying to be really comfortable in Winter, when he introduces the electric heater and tells you how you can transplant the fresh, balmy air of June into the middle of January, and not for one day only, but for as many days as you like and that, too, without any of the evils which he has just been describing. The cause of this delightful change may not be visible, it is concealed artfully in the panel or base-board of the room and is made to match the wood. The air seems pure, there is a sense of warmth and there is absolutely no dust, no smell and no noise to suggest that work is being done somewhere to produce this warmth. A simple switch controls this hidden worker. As an enthusiast puts it, "you press the button and the power house a mile away does the rest." This sounds like a fairy tale,

"Little goat bleat,
Little table arise," etc.

but it is almost the literal truth.

The cost of electrical heating is, as I have said, more than that of other methods, but there are many, their number is increasing, who think that the decrease in damage of books, ornaments and furniture, and the freedom from annoyance which it guarantees, more than compensates for the highest cost. These are wealthy men. But now that the "Wizard of Menlo Park" is said to be perfecting a new heater, I think that the day is not far distant when those whose books are few and whose ornaments and furniture are simple and cheap may also realize in their home another of the wonders of electricity.

ERECTING STEAM PLANTS.—III.

BY JAMES F. HOBART.

In the last paper (March 15) the work had progressed far enough to provide the data necessary for erecting the chimney. The cross-sectional area can be determined directly from the area of the tubes, and the area of the chimney should a little more than equal the combined area of all the tubes. The latest engineering practice has shown that it increases the draft to make the top of chimney with a greater sectional area than the bottom. The intensity of a chimney draft does not increase in proportion to the height of the chimney, but in proportion to the square root of the height, therefore, if a chimney 49 feet high has a draft of 0.25" of water, a chimney 100 feet high will have a draft, not of 0.5", ($\frac{100}{49} \times 0.25$) but it will have a draft of 0.35" ($\sqrt{\frac{100}{49}} \times 0.25 = \frac{10}{7} \times 0.25 = 0.35$).

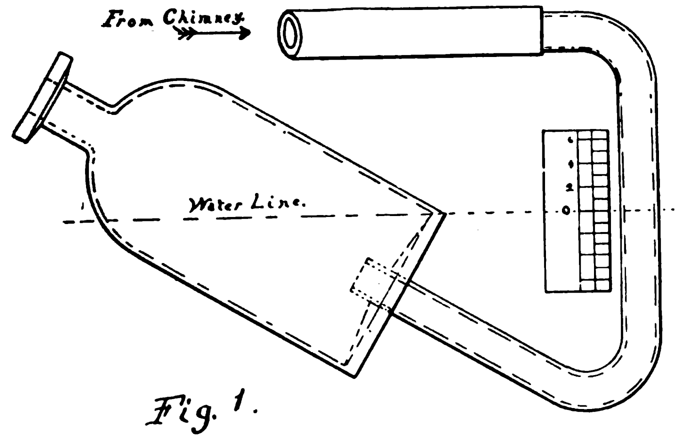


Fig. 1.

Thus knowing the number of cubic feet of air that must be drawn through the chimney per minute to consume the necessary amount of coal, the area of chimney being known, the velocity of the escaping gases may be readily calculated, and by taking from a table, the inches of water vacuum necessary to correspond with a given velocity, the height of chimney may be readily figured out. A rule may be figured out to determine the relation of volume of escaping gases, area of chimney, and height (both in feet) without going to the trouble of the water-pressure business. The rule is as follows:—multiply the square root of the height by one-tenth the area of cross-section, and product will be the volume of draft.

A handy formula for directly determining the area of top of chimney, is to divide 15 times the amount of coal (in pounds) consumed per hour, by the square root of height of chimney in feet. It should be remembered that the higher the chimney, the less can be the temperature of the escaping gases to maintain a given draft. The diameter of a chimney at the bottom (internal diameter, should be one-tenth, or one-eleventh the height of the chimney. The outside batter of the brick-work ought to be 0.35" per foot. It is well to calculate the outside diameter of base from the internal diameter at top, allowing for the necessary batter, and making thickness of wall at top, equal to one brick (8") for diameters up to four feet, and 1.5 bricks for diameters over four feet. For very high chimneys, another factor, that of weight upon the foundation, must be introduced, and not over 25 tons per square foot should be allowed, and even with that weight, the brick should be laid in the best hydraulic cement.

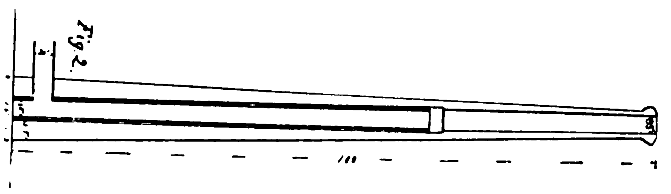
For chimneys 100 feet in height, and less, the following table will be handy for finding the velocity of the heated air in the chimney, in feet per second.

AIR AT BASE OF CHIMNEY.

External Air.	150°	250°	350°	450°
	Feet.	Feet.	Feet.	Feet.
10°	24	30	33	35
32°	22	28	31	34
50°	20	27	30	33
60°	19	26	29	33
70°	18	25	29	32
80°	17	24	29	32

When the height of chimney is less than 100 feet, it is only necessary to multiply the velocity as obtained for temperature by one-tenth the square root of the height of chimney in feet.

It is well to bear in mind that the most effective draft of a chimney is when the absolute temperature of the hot escaping gases is about the temperature of melting lead, or as 25 is to 12, when compared with the temperature of the external air.



There is always some loss of draft occasioned by conveying the products of combustion through connections to the chimney, but when these are short, they are neglected. It is well, however, to calculate and allow for such losses when the uptake and connections are long. This may be done by means of the following formula:—

Let V velocity of gases in feet per second.
" h head of water pressure (or vacuum) in inches.
" d diameter of pipe, in feet.
" l length " " " "
" C perimeter " " "
" a area of section in square feet.
" Q volume of air discharged per second in cube feet.
" Q also equal Va.
" HP horse-power

Then in round passages:—

$$V = 396\sqrt{\frac{hd}{l}} \quad h = \frac{V^2 l}{156800\,d} \quad Q = 311\sqrt{\frac{hd^5}{l}} \quad HP = \frac{Vd^2h}{135} \text{ or } \frac{V^3d^2l}{21200000}$$

In other forms of conduits:

$$V = 796\sqrt{\frac{a\,h}{C\,l}} \qquad h = \frac{v^2Cl}{633000\,a} \qquad Q = \sqrt{\frac{a^3h}{C\,l}}$$

$$HP = \frac{Vah}{106} \text{ or } \frac{Qh}{106} \text{ or } \frac{V^3Cl}{67000000}$$

In all these calculations, an inch of water is taken to be equal to 5.2 pounds per square inch for passages of any shape. A pipe connected to the smoke passage, and attached to a bent tube, forms an efficient draft gage. The other end of the tube should be cemented to a large bottle filled with mortar, so that the fall of water therein, coming from so large a surface, may be neglected in the calculations. Fig. 1 illustrates a draft-gage of this kind. It is cheap, and may be constructed by any engineer.

Fig. 2 represents a 100-foot chimney, designed according to the foregoing instructions, to develop 120 H. P.

(To be continued.)

Electric Heating Apparatus Making Headway.

One concern alone that supplies electric-heating apparatus has received orders for it from 60 electric street railways for use this Winter. It has long been the practice to light electric cars with incandescent lamps fed directly from the overhead trolley wires, and a large proportion of the 400 American electric roads are now so equipped. As a further stage of evolution, the electric car-heater has become a necessity, and its success is firmly established. As a matter of fact, its use on large electric roads has not been found to make any perceptible difference in the coal consumption at the power house—*i. e.*, the current required for the heaters does not appear to add anything to the amount of current normally required to operate the cars under ordinary conditions when no heat is wanted. This has been tested a good many times with invariably the same result, showing that the heating current is an inappreciable addition to the average "load" of the station. It has been objected that as the electric heaters now cost four or five times as much as the common car stove, the chances are against their introduction. This does not prove to be the case at all. Coal stoves occupy at least the space of one seat in the car. It is not pleasant to sit next to them; it is equally unpleasant to face them But the electric heaters go under the seats, like steam pipes, and the only sign of their presence is the steady warmth that they engender. This employment of electricity is already so general that several kinds of apparatus are competing in the market, and so many improvements have been made that it is now seriously proposed by one of the largest steam railroads in the country to use these heaters on such of its cars as are now lighted electrically.—[Engineer and Iron Trades Advertiser, Glasgow.

CARNEGIE, PHIPPS & Co. will add to the armor department of their Homestead mill a steel saw weighing 110 tons, that will cut a nickel steel armor plate as an ordinary saw walks through a plank. These armor plates weigh from 8 to 38 tons, and are 20 feet long and 20 inches thick.

SPECIAL NOTICE to Readers:

The Premium Offer in the March 1st issue is open to regular subscribers and their friends until further notice.

SCIENTIFIC MACHINIST

Formerly. WESTERN MACHINIST.

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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain or brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, APRIL 15, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

SHALL THE ENGINE OPERATOR NOT BE CALLED ENGINEER?

It has been suggested that some other name be devised for the men who run engines than *engineer*. The point is raised that the professional man is confused with the mechanic, and vice versa, to such an extent as to be troublesome. This is probably true, and some advantage might be gained for simplicity by an alteration in the name of one of these callings, but we think it would be more proper to coin some other title for the professional man than for the mechanic. As long as the machine by means of which steam is used to produce power is called an engine, so long will it be very appropriate to designate the operator as the *engineer*.

It is said that in France the men who run engines are known as *machinists*, and only the book and university men are given the cognomen of *engineer*. This is a fact and it is probably nearer to what it should be than is the custom in English-speaking countries, but it does not argue with any force that we would be acting wisely to overturn an established usage for the adoption of it.

The engine used on the railroad is not known by that name as much as by that of locomotive. The operator might, with less inappropriateness, be styled the *locomotiveman*, if he would consent to it. It would not be a very radical change to substitute *engineman* for engineer, but still we doubt that even so slight a change can ever be brought about.

The easier way, as suggested above, is to get up a new appellation for the theoretical man. The title *civil engineer* has come to stay. It is quite distinct and can not well be misunderstood. *Mechanical engineer* is not as clearly outlined, but yet it is stuck on us pretty fast and would come off with difficulty. If the meaning of this title can be restricted to machinery construction and design in general, and a new one created for the business and science of building and installing steam plants, would that not be preferable to attempting an arbitrary modification of the name by which the many thousands of men who operate engines are known? The last named might be called, *power engineer*. No one could misunderstand the meaning of prefixing the word *power*.

We would be pleased to hear from our contemporaries and readers on this point.

"THE TECHNO-CHEMICAL RECEIPT BOOK," from the most celebrated scientists of the world, is one of the veay best books on mechanical science, because it is practical. Eveiy mechanic can find something useful for every day life in it. The price is $2. It is published by H. C. Baird & Co., 810 Walnut street, Philadelphia, Pa. The advertisement of this firm, published elsewhere in this issue, gives interesting details concering this work.

THE oft-discussed problem of a substitute for dynamos in electric lighting by providing a cheap, inodorous, inoffensive electric battery, capable of supplying sufficient light for domestic uses, is again claimed to be solved by M. Poudrous of Paris.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(354.) F. A. W., P——berg, O., writes: 1st. "Kindly give me information in regard to the following in your next issue: The engine I am running is a stationary of a slide valve pattern. She furnishes power for a saw mill and box factory, when run with 90 pounds pressure. When ever I give her steam it passes out in the exhaust, and before she will start there comes a sharp snap, the steam ceases to flow, or exhaust, and she starts. The snap appears to come from the valve being tco loose on the stem, and if I loosen or tighten it on the stem it acts the same. 2nd. Is it necessary to run the exhaust to the top of the tank into which I pump the water from the well and then pump it through the heater into the boiler? Do I gain by both?" *A.*—1st. The snapping is undoubtedly caused by valve seating again, leaving the seat when there is no pressure in the chest. 2nd. You had better run your exhaust to top of tank.

(355.) "Leather," Akron, O., writes: "Kindly inform me through your valuable paper, how I can determine, (without the use of testing instruments,) when putting on a 24″ 2-ply leather belt, 60 feet long, when it has reached the proper tension, so that it will not need taking up for four or five weeks." *A.*—A good rule is to allow belts to sag ¾″ for every eight feet between pulleys.

(356.) W. H. H., Elkland, Pa., writes: "I like your paper and can not see why you do not make it a weekly. I am running an engine 16″x24″. There is a little pound and it is hard to locate. I first thought the pin in the cross-head was loose. Now, if I place the crank pin on the back center, and draw the packing level with piston (if it is not level), and if the pound still remains, shall I take out piston and see if follower head is tight?" *A.*—There are a great many things that could cause this pound. It would be necessary for one to inspect the plant to locate the pound. We could not undertake to tell what might be done to remove it, without more exact information. Sometimes "monkeying" with an engine makes it run worse.

(357.) J. W. R., Linconville, Kan., writes: "A great deal has been said of late in mechanical papers about wrapping large steam pipes with wire or clamping them with iron bands to make them withstand a higher pressure. Now, why can not internally fired boilers be wrapped or banded in some way to make them stronger? If wrapping them with wire will be practical, please state size of wire, method of wrapping and how to fasten the ends together. The boiler that I want to strengthen is 29″ in diameter." *A.*—We do not think that wire can be wound on steam pipe tight enough to add much to the pipe's strength. Iron bands, if shrunk on, would strengthen it, but to do it properly would cost about as much, we think, as new pipe, equal to more pressure than the old pipe thus strengthened. We do not think that wire or bands could strengthen the shell of a boiler.

(358.) "Subscriber," Oberlin, Kan., writes: 1st. "I am troubled with a knock in the back end of the cylinder of my engine. Have tried for the past six months to stop it and have only partly succeeded. It knocks as the engine passes the back center, running over. Have lined the engine and cut a rim out of the end of cylinder and have done everything I could think of, but have failed to stop it. Sometimes it will run a half-day perfectly smooth, then begin to knock, and sometimes it will knock every other stroke, or every few strokes. Can you suggest a remedy? The engine has been run five years." *A.*—It is hard enough to tell what produces the pound in an engine when on the ground, and to arrive at it from description is almost impossible. But there are two things which we think may be the trouble with your engine. The piston may not pass the counter-bore of the cylinder, and the wear may have produced a shoulder. Again, it may be water. Leave the cylinder cock on that end open a little, and if it does not stop, take out the piston and see if there is a shoulder. If so, file it off. Then see if the pound does not disappear. You have not as much clearance in the back end as in the front end of the cylinder. Keying up the connecting rod shortens the piston, bringing it nearer the crank, and when there is very little clearance a small quantity of water will make a thump, and it will not come with every stroke, either. Try these, and if you don't get the pound out, let us know. 2. "I am running a slide valve engine, and carry 100 pounds boiler pressure, and I find that the engine will carry its load and keep up regular motion, down to 60 pounds pressure. Is it economy or waste of fuel to carry 100 pounds? I think it is economy, while other parties here doubt it. If it is, or is not economy, please answer." *A.*—If you cut off shorter and use only as much steam as the work requires, there will be economy resulting from high pressure. But if you do not, more steam will be used than you need and there will be no economy over low pressure. If you have a graduated cut-off you can regulate this very easily. There is another point in favor of high pressure which may be of particular advantage to you. With high pressure there will be less condensation of steam and therefore less water in the cylinder to give trouble. But don't cut off to short.

(359.) N. M., Boonville, Mo., writes: "We are fixing a pump, a Buffalo duplex steam pump, and used the same throws that were on when it came to the shop, but one piston makes about one inch more stroke than the other. Will you kindly inform us how we can remedy and make them have the same stroke?" *A.*—Take off the steam chest cover, put piston on center and see what position the valve has on the opposite cylinder.

They should be exactly alike. If any are not, give them (the steam valves) the same lead at both ends. Do not set nuts so tight as to bind the valves, and set up the jamb nuts so as to keep them from getting loose. You might look at the packing around the piston rod and see that it is not too tight. The following is the answer to a similar question, No. 343, in a recent issue: "When one piston, it matters not which, is at the end of its stroke, adjust the valve of the other cylinder so that it will have the desired amount of lead for the opposite stroke. Do the same with the other cylinder and set the valve by its sister cylinder. If the valve opens more at one end than at the other, adjust it with the nuts on the valve stem until there is the same opening at each end of the stroke."

(360.) Virginian, Salem, Va., writes: "We have a 'Stillwell' heater connected to our engine exhaust. Our pump is broken and useless. We are using at present a 1½″ injector, taking water from a well, and feeding the boiler through the blow-off pipe. The blow-off pipe is four feet below the water line of our heater. Can we make the injector take the water from the heater and feed the boiler? What would you suggest? 2. We have a quantity of mineral wool, and want to cover our steam pipes. Will flour and water mixed with it make a good covering?" *A.*—1st. Perhaps you can use the injector for feeding the hot water to your boiler by placing it below the water line of the heater, so that the water will flow into it. It will probably force the hot water all right. 2nd. Make your wool into sections. If you do not know how perhaps you can get some ideas from the following: Make a roller of wood the diameter of the pipe to be covered and three or four inches longer than the section you wish to have. Place two boards parallel with each other, with the inside edges as far apart as the length you want the sections to be. Saw two narrow strips the length of the sections and place them between the boards, parallel with the roller and as far apart as the outside circumference of your section of mineral wool. The space, or square, between these boards and strips will be the dimensions of the sheet of wool with which the section is to be made. Cut a piece of cloth the length of your section, but wider than the distance between the strips and lay it in this space, with the lap all on one side. On this lay a piece of brown paper that fits exactly in the space between the boards and strips. Now sprinkle on wool and pack and smooth it by rolling the roller over. The section is made by rolling this sheet of wool, paper and cloth on the roller and pasting the cloth around to hold it in cylindrical form. If the measurement has been right, the sheet will just go around the roller and not lap. But before rolling, wrap a piece of asbestos paper around the roller. Now roll up your sheet of wool and paste the outside cloth around. When you want to put it on the pipe slit it through, adjust nicely and glue a cloth around. You will, if you have done careful work, have a neat fitting section. After one is made others can be finished more rapidly.

☞Readers are cordially invited to send us any questions, comments, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—ED.

ADDITIONAL CORRESPONDENCE.

A Good Record.

EDITOR SCIENTIFIC MACHINIST:

Probably one of the best evidences of an engineer's ability and efficiency consists in keeping the boiler, engines, pumps, heaters and piping in such a condition as to keep the plant running continuously at a minimum cost for repairs. Spurting is all very well, provided nothing is strained, which is likely to occur. Mr. David H. Palmer, an engineer of Columbia, Pa., is entitled, I think, to credit for continuous running, as follows: The engine is a Harris Corliss, 14″x36″, makes 80 revolutions or a piston speed of 480 feet per minute. The steam is generated by a horizontal tubular boiler 6x15 ft. This plant has been running day and night continuously, except Sundays, for two years, without making a single stop for any purpose whatever on account of the motive power—not even a bearing heated enough to give any trouble. Rivalry of this kind among engineers is honorable and profitable, alike to employers and employes. If there were more engineers of this kind, there would be better and more satisfactory work done in many an industrial establishment than there is at present. If there is any engineer who can make a better showing, would be glad to hear from him. C. B. H.

Prick-Punching—Bull-Headed Engineers.

EDITOR SCIENTIFIC MACHINIST:

In the issue of March 1st, 1892, in regard to prick-punching a misfit, I will add that a few years ago I had charge of a large Lane & Bodley engine on which the same remedy helped me out. When I took charge the owner of the mill told me she had been pounding some for some time. The engineer could not locate it. Well, I located it in the crank pin very soon. I took it out and prick-punched it nicely, put it back and drove the key home; time about 35 minutes. She ran till the mill burned, which was two years after, without a pound.

Now, I don't advocate this as a remedy in all cases, yet I know it is worth trying in some, but must be done well, and will generally give good results.

I will now state a few little things which sometimes disgust a fellow. During a cold snap, recently, I was one morning called to help fix a pump. We got things thawed out and tried to start the pump. She refused to go. I went over it carefully and tried again; no use. I then asked the (so-called) engineer if he had the water end off, and he said not. Well, I did not take any stock in his say-so, and I took off the end and found the nuts gone that held the plunger on piston rod. Now, then, what had become of them? We could not find them nor do we know to this day where they are. These nuts being off was due to the fact that the rod went back and forth, leaving the plunger stationary, therefore it would run but would not pump. We put on nuts and she started right off. The whole sum and substance of this pump story is this: You see this engineer (so-called) had that morning packed the plunger, and in doing so had taken the nuts off the rod (I don't know what for) and lost them, but would not acknowledge it at the time, but laid the blame on a frozen pipe. There was some pipe frozen but not sufficient to stop the pump.

He also got a set of brass oil cups for his engine, made by the Sherwood Manufacturing Co., Buffalo, N. Y. The first day he condemned them; no good at all. Well, I asked him what ailed them. He said they run empty in spite of him. I suggested to him that probably the sliding cover leaked instead of the feeder, so I went to the engine and got one and adjusted it, and she is on yet, as are the others, and doing well.

I simply write these, Mr. Editor, to show how "bull-headed" men get and argue their point even after they know they are wrong. I could go on and tell you many little instances, but will refrain from taking your valuable space. But should this be worthy of publication I may write again.

You will find enclosed renewal fee for paper. J. E. J.

Criticism of an Engine.

EDITOR SCIENTIFIC MACHINIST:

In your latest issue of the SCIENTIFIC MACHINIST, I notice a cut and description of a machine called an engine (the Dake). I would like to express an opinion on its merits, judging from the cut in your paper, only, as I have never seen or examined one, and I may as well say right here, that my opinion of the whole affair is a poor one. My first objection to the machine is its square piston. As all good mechanics well know, it is utterly impossible to keep them steam-tight and almost next to impossible to even make them so from the first. My second objection is, that the thrust of the steam is not in a direct line with the center of the piston. The consequence is that the piston receives a rocking motion, making it move backward and forward, first on its toe then on its heel, causing excessive friction and wear.

Suppose we were to take, say a 25 horse-power common slide valve engine and would throw away the connecting rod, and substitute in its place a link with block to receive the wrist-pin, we would then have just the same amount of unequal thrust and resistance as in the Dake machine. And yet, would not this be a more serviceable machine, as we could have a tight piston and valve? And I doubt if a man with only the reasoning faculties of a Farmer's Alliance lecturer would not call it an imposition on him, to try to sell him such a machine.

I maintain that it is impossible to keep the faces of the inside cylinder of the Dake machine sufficiently lubricated to prevent their cutting themselves and the piston in their infancy. As there is the entire power exerted on the horizontal piston to be resisted by the inside piston, the friction must be enormous. JOS. NAMUR.

Bad Boiler Explosion.

EDITOR SCIENTIFIC MACHINIST:

I will give you an account of one of the most terrific boiler explosions I have heard of. It occured at Fidelity, O., March 25 last, at about seven oclock A. M. It was in the sawmill of Lephard & Son, and had formerly been in a stillhouse and was quite old. The place being about four miles from here, I made all haste to get on the ground after hearing of it. The first evidence I found, was that the flues (it being a two-flue boiler) had collapsed and torn entirely from the shell, and into four pieces. Three pieces were within fifteen feet of the furnace. The other piece, about one-half of a flue, had followed the shell about 100 feet and fallen out. The shell rose up and shot back, striking the ground about 150 feet, then bounced and struck a frame house, cutting away the upper corner of the second floor two-thirds across the building, passing on through a tree top, and ploughed into the ground about 125 yards from where it originally started.

There were five men in the mill when it occured. Three were dead when help arrived. One died while being taken home and the fifth died about seven o'clock the same evening. The last one was unconscious and there were none left to tell the tale, but every evidence indicated low water. I found the flues with the lime burnt off about one-fourth of their diameter. This part was the upper part of the flue and had gone down with such force as to mash onto the rivets of the lower part and indented the upper part, fracturing the irons, which shows that it was very brittle from use and age. About two-thirds of the front head was blown off, which caused the almost complete shell to shoot back with such terrible force. The shell right over the grate bars was more than half gone, leaving it about $\frac{3}{32}$″ thick in places, showing it to be very old.

This piece of carelessness on the part of the firemen in not seeing that there was at least one gauge of water, makes five widows in very close circumstances, and should be a warning to all who have the care of steam boilers to be sure of the water line before putting fire under the boiler.

W. D. J. EVERET, West Milton, O.

Superheated Steam.

The question of superheated steam is treated in a very original manner in *Die Natur*, a German publication, a parallel being drawn between the action of a steam boiler and the eruption of a geyser. In the latter case, according to Bunsen, a cavern filled with water lies deep in the esrth, under the geyser, and the water in this cavern is heated by the earth's eternai heat far above 212°, since there is a heavy hydrostatic pressure upon it arising from the weight of water in the passage or natural stand pipe that leads from the subterranian chamber to the surface of the earth; after a certain time the temperature of the water below rises, so that steam is given off in spite of the pressure, and the column in the exit tube is gradually forced upward. The release of pressure and the disturbance of the water then cause the contents of the sebterranean chamber to flash into steam and expel the contents of the exit pipe violently.

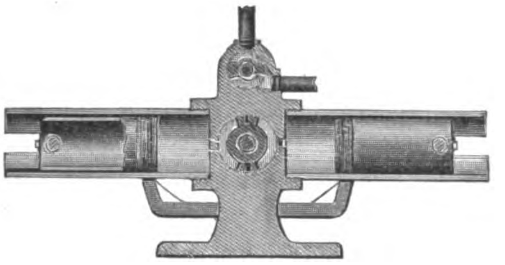
Practical Letters.

Valve Mechanism for Steam Engines.

EDITOR SCIENTIFIC MACHINIST:

I send herewith a description of a valve mechanism for engines, also a cut, a poor one, but the best I have. The valve gear and its adjuncts form the large part of the expense in engine construction, and a proportionate amount of care to maintain in proper order. This invention relates to improvements in steam engines of the reciprocating type; and the purpose thereof is, first, to provide a novel construction and combination of parts whereby a duplex engine is provided, consisting of the minimum number of parts, combined with a valve which receives continuous rotation from the converted piston heads, the construction being such as to materially simplify and cheapen the cost of manufacture by wholly dispensing with the vibrating or reciprocating valves usually employed upon the direct-acting engines, and by avoiding the necessity of packing and stuffing boxes of the kind generally employed.

It is the purpose, secondly, to provide a novel valve mechanism for direct-acting engines wherein they shall have continuous and uniform revolution, which shall be imparted from the power shaft of the engine, with which the rotating valve is so connected that it shall always find its seat without regard to the exact concentric relations of the shaft, the construction of the valve being such that the live steam supply and exhaust to and from the opposite cylinders shall be reciprocally synchronous.



The invention also has for its purpose to provide a simple rotary reversing-valve, which is interposed in the steam-passage, the construction thereof and its combination with the steaming-valve being such that a steam-chest is not required, while the number of the operative parts is reduced, and the labor and expense of manufacture are very essentially diminished.

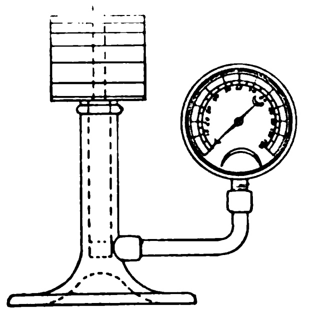
It is claimed by the inventor, Mr. Phillip Zimmer, of Hammondsport, N. Y., that such an engine can be constructed and maintained at about one-half the cost of the engines of the same type now in use.

Gauge Testers.

EDITOR SCIENTIFIC MACHINIST:

Thinking that any writer in the SCIENTIFIC MACHINIST should be willing to have his work criticised in a friendly way, I will respectfully call the reader's attention to the sixth and seventh papers by Mr. Woodward, under the heading "Hints to Engineers."

Referring to the sixth paper I will say that the gauge tester he illustrates is both crude and unreliable. It would do as a make-shift if nothing else could be had, but there are others that ought not to cost as much, taking everything into consideration, besides being satisfactory, as well as accurate for any desired pressure. I enclose a sketch of one similar to one that I saw several years ago. It is simply a loaded piston working in a cylinder, having one or more branches to which gauges may be attached. To use this tester, you attach your gauge to it as shown, take out the piston, fill the cylinder partly full of water, oil or glycerine, the latter being preferable, then put in your piston, which we will suppose to have a diameter of 9-16″, equal to very nearly ¼″ area, and that it, and a plate fastened to it to support other weights, weighs 2½ pounds. We now give the piston a whirl to relieve it of vertical friction, when, if the communication from the cylinder to the gauge be free, and the gauge correct, it will register 10pounds. Correct or not, we put on a 10-pound weight when the gauge should register 50 pounds, if it does not we make a note of it and put on more weights, till the maximum presence has been reached, when if the gauge has shown correct all the way around it needs nothing, but if it has been light or heavy at different pressure, then if it can not be corrected by the levers which are made so they can be altered, then the gauge should go to the factory for repairs.



With this instrument a gauge may be taken on and tested (not corrected) in five minutes, and returned to its place on the boiler. Every engineer should have some way of testing his steam gauge, and I know of no more accurate or cheaper means of doing it than with one of these testers. I will call the reader's attention to the importance of giving the piston a whirl to relieve the vertical friction on the piston, each time a weight is applied to the piston, for upon this depends the accuracy of the instrument. It may also be used with an accurate gauge, as a pair of scales for weighing small articles where a close approximation is all that is required.

Referring to the seventh paper I will say that I cannot see what difference it makes whether there is air in the boilers or not, so long as there is plenty of water, before lighting the fires. Surely, air or the lack of it can make no difference in the amount of water or its weight in the boilers. For condensing engines air should be allowed to escape from the boiler as steam is raised to permit it from getting into the condenser through the engine. But for non-condensing engines I never knew of any trouble to arrise from leaving the air in the boiler. However, I do not recommend the practice. I only object to the philosophy given by Mr. W. for so doing.

M. C. MAC.

COMPARATIVE TEST OF HIGH AND LOW SPEED ENGINES.

Chas. W. Wason, electrical engineer of the East Cleveland Street Railway Co., read before the Cleveland Electrical Club, at its last meeting, a paper, of which the following is an abstract:

Having high speed and Corliss engines in our power house, I thought it of sufficient interest to make some comparative tests relative to the economy of the two types of engines. A brief description of our plant may not be out of place. Three Armington & Sims engines 14½″ x 15″, and three others, 18½″ x 18″, of the same make, compose the high speed portion of our power plant. To each small engine are belted two Edison generators of 40,000 watt capacity, and to each large engine are belted two 800,000 watt generators, manufactured by the same company. In the other part are two 28″ x 48″ simple Corliss engines, made by the C. & G. Cooper Co., belted to a countershaft 7″ in diameter and about 80′ long, with four clutch pulleys 88″ in diameter by 28″ face, made by the Hill Clutch Works, and from the countershaft are belted four 175,000 watt Edison generators. Our steam plant consists of 14 tubular boilers 18′ long, 72″ in diameter, with 72 4″ tubes with Murphy settings. We have been able to use the same boilers in each test, selecting those that would equalize the distance the steam was carried in each test. Laboring under the disadvantage of not having an ampere meter of sufficient capacity to carry the entire current, we were obliged to station a man to read the individual ampere meters of each machine, these men taking the amperes upon the sounding or a gong every 15 seconds. The water used for steam passing through a meter, it was an easy matter to determine the quantity used during the 10 hours. Each wheelbarrow of coal thrown on the floor was weighed, so that we knew the number of tons burned. An accurate account of the number of motors and tow cars moved and mileage made by each was kept. Hourly readings of the thermometer were taken, and the condition of the weather noted. We used an automatic steam registering gauge. The temperature of the water as it left the Berryman heaters was taken every 15 minutes, also as it ran from the street main. By taking readings of the quantity and pressure of the current every 15 seconds, or, in other words, 2,400 readings in 10 hours, a very fair average of the electrical output has been obtained. Owing to the constant and rapidly varying load, it is about impossible to get the mechanical horse-power. In taking a card with the indicator the load will change before the stroke is completed. I would very much like to hear from any one who has a device that will accomplish this purpose. I expected to find a greater difference in favor of the low speed over the high speed Of course we have the countershaft to run in the former, and this load does not come in on the latter, giving in turn a factor of flexibility that is of importance.

The following is the data of tests taken Feb. 14, with high speed, and Feb. 21, slow speed plant:

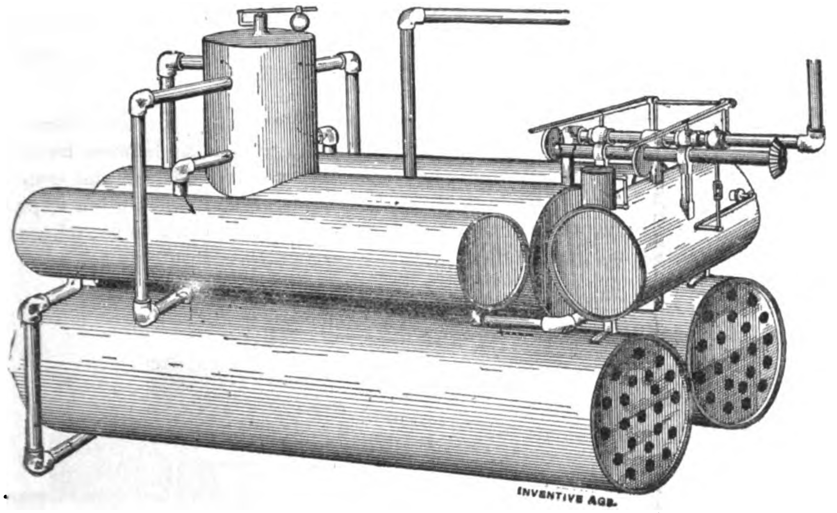
	February 14.	February 21.
Av. electrical h. p. developed in 10 hours	563	630
Max. electrical h. p developed in 10 hours	813	842
Min. electrical h. p. developed in 10 hours	486	354
Number gallons oil used in 10 hours	7 gallons.	8 gallons.
Water consumption for 10 hours	3,900 cu. ft.	3,800 cu. ft.
" " per average electrical h. p. per hour	43.29	37.69
" evaporated per lb. coal per hour	6.61 lbs.	6.54 lbs.
Bituminous slack coal used in 10 hours	36,900	36,300
Ashes made in 10 hours	4,890	4,779
Fuel used per average electrical h. p. per hour	6.55 lbs.	5.76 lbs.
Combustible used per av. elec. h. p. per hour	5.68 lbs.	5.00 lbs.
Pounds of coal per car mile	6.57 lbs.	6.38 lbs.
Average amperes per 10 hours	812	907
Maximum " " "	1,120	1,160
Minimum " " "	720	720
Average voltage " "	518	518
Maximum " " "	535	530
Minimum " " "	505	510
Number of readings of 15 seconds intervals	2,385	2,395
Av. temperature of water from heaters	186° F.	197° F.
" " " street main	39° F.	39° F.
" " the outside atmosphere	43° F.	41° F.
Condition of weather	Rainy.	Foggy.
Av. steam pressure	96 lbs.	97 lbs.
Maximum steam pressure	102 lbs.	100 lbs.
Minimum " "	90 lbs.	90 lbs.
Average chimney draught	⅞ inch.	15-16 inch.
*Number of motor cars run on the line	62	62
" tow cars run on line	9	10
" miles made by motor cars	4,640.02	4,627.39
" " " tow cars	767.65	806.53
" passengers carried on cars	12,366	15,462
" miles made by Brooklyn motor cars	61.75	87.28
Number miles made by Brooklyn tow cars	30.87	43.64
" " " Broadway motor cars	117.10	117.10
Number of Brooklyn motor cars	4	4
" " " tow cars	2	2
" " Broadway motor cars	5	5
" " " tow cars	None.	None.
Total number of motor car miles	4,818.87	4,831.87
" " tow car miles	798.52	850.15
" " motor cars	71	71
" " tow cars	11	12
" " motor and tow cars	82	83
" " car miles made from power developed	5,617.39	5,681.94
Average horse-power per car	6.86 h. p.	7.59 h. p.

*Fifty-four of these are No. 6, and seven are No. 14 Edison, with one **Thomson-Houston** "S. R. G.," 15 h. p.

THE master mechanics of the Pennsylvania R. R. are recognized throughout the United States to be high authorities on machinery. They recently visited the works of the Lodge & Davis Machine Tool Co., at Cincinnati, and after thoroughly examing into the mode of construction as carried out in these works, the Pensylvania R. R. have entered into a contract with the above company for a large equipment of their improved machine tools to be distributed amongst their various locomotive shops.

STEAM GENERATOR WITH FEED-WATER DEVICE.

The improved steam generator on which letters patent were issued to Samuel S. Fleming, of Sarversville, Pa., in February, 1891, was followed February 2, 1892, by the patenting, by the same inventor, of a feed-water mechanism for steam boilers. The former of these inventions, which is shown in the accompanying cut, has to do with steam generators employing sectional boilers. The generator embodies simple and improved means for effectively supplying water to it while it is in use, the boiler sections being readily connected or separated for the purpose of transportation or for adapting the number of sections to the power required. It has the advantages also of simplicity, inexpensiveness and durability. The illustration shows twin boilers provided with flues and adapted to be placed upon any suitable setting. Twin water tanks, cylindrical and extending longitudinally with the boilers, are placed over the latter and a dry steam drum is interposed between these tanks, with its lower circumference resting upon the boilers. This dry steam drum is thus placed, in order that the steam may be better reheated as it passes out to the engine, and also to give compactness to the whole structure. A vertical steam-receiving dome is mounted upon the top of the forward portion of the dry steam drum and receives the steam directly from the boilers through pipes. Any condensed steam will be carried off through lateral pipes leading down to the tanks, while the live steam passes on down through pipe leading into the front end of dry steam drum. The water tanks and dry steam drum are shortened at the rear ends to accommodate an auxiliary water cylinder or tank, placed transversely over the rear ends of the boilers. The supply of water enters the top of this tank through valved pipe and branch pipes to the water tanks, thence through these tanks into the boilers through branch pipes. It is then generated into steam, which rises into dome, thence passes down through pipe and out through dry steam chamber and up through pipe to the engine. The generator will be made of 10 or 12-inch tubing—all pipes to be fitted with unions, so as to be readily taken apart, for convenience in handling.



The contrivance for automatically supplying the boilers with water is indicated in the upper right-hand portion of the cut. The auxiliary water tank, which is placed transversely over the rear ends of the boilers, has a dome, which contains a float. The float actuates a governor-valve through the medium of a bell-crank lever, fulcrumed in the side of the tank and a vertical rod. The latter is provided with a turn-buckle for adjusting its length, and hence regulating the amount of cut off to the valve and the supply of water to the tank. The dry steam cylinder is connected with the pipe and tank through short vertical pipe. The flow of water from the auxiliary tank through pipes is regulated by a valve, which is operated by a rod connected to lever, whereby both the valves are opened simultaneously, one to draw off the water and the other to admit steam into the tank to overcome or balance the back-pressure from the boiler.

ADVANCE NOTES OF THE WORLD'S FAIR.

Special World's Fair Commissioner Alexander Campbell has returned from Australasia, and reports great enthusiasm over the Exposition. New South Wales, South Australia, Victoria, Queensland, New Zealand and Tasmania are all making extensive preparations. Three new steamers between Sydney and San Francisco are about to be put on.

Michigan's building will measure 100x140 feet and be three stories high. It will be constructed of Michigan material, which, with the furnishings, will be donated. Though but $20,000 of the appropriation will be devoted to its erection, it will in reality be a $50,000 building.

We have not heard anything for several weeks of the proposed combination of the colonies in a national Australian display at the Chicago World's Fair, but we hope that this matter will not be allowed to slide until irrevocable arrangements are made for the separate representation of the colonies. The forthcoming Exhibition is to be a collection of very big things, and nothing but big things are likely to command very much attention. It would, therefore, be a fatal mistake for the colonies to suppose that they will make anything like a proper impression upon the visitors to the Exhibition by allowing petty provincial ideas to sway them, and by arranging for separate and distinct representation in a series of small courts instead of combining to make an effective united display worthy of this great country. We hope that at least the arrangements for displaying the mineral wealth of these colonies, and at the same time securing information likely to prove of value to us in the treatment of ores, and so on, will be of federal rather than a provincial character. —[Australian Mining Standard, Sydney, N. S. W.

At a meeting of the Board of Management of the British Iron Trades Association a letter was read from the Secretary to the British Commission on the Chicago Exhibition, requesting the Association to co-operate in bringing together a representative collection of British minerals and metals to be shown at Chicago, and intimating that "as the collection once formed would be presented to an American museum, the Commission believe it is worth while to take some little trouble to carry the suggestion into effect." It was resolved to bring the matter under the notice of the members of the association, and to invite them to send in typical samples towards a general collection as proposed. The president was requested to prepare and read, at a special meeting of the association, a paper on the Chicago Exhibition from the point of view of the iron and steel industries of the United Kingdom, the meeting to be called to discuss the papers in May next.—[London Colliery Guardian.

The principal part of the Bethlehem Iron Co.'s space at Chicago will be devoted to marine work. A battle ship shafting 125 feet in length, specimens of armor plate, guns, projectiles and various naval appliances will be shown. An armor plate ingot weighing about 100 tons will be an important item. The company will also erect a full-sized model of their famous 125-ton steam hammer, said to be the largest in the world.

An Ohio World's Fair Commissioner has estimated that the exhibitors from his State will spend upwards of $5,000,000 in the preparation of exhibits for the Exposition.

Speaking of the steps Germany should take toward representation at Chicago, *Kuhlow's German Trade Review* says: "One thing is certain, if German industry is to maintain our honorable position on the other side of the Atlantic, then the necessary steps should be taken without loss of time. It is intended to suggest to the Reichstag the advisability of a further contribution to the expenses of the exhibition, but it seems very doubtful whether the majority do not feel that sufficient has already been done in the way of state aid. It is by no means a long time before the Exhibition is opened, and as it is some very great efforts will have to be made so as to be ready in time."

Bulgaria has decided to take part in the Exposition. Foreign participation, so far as ascertained, embraces 72 nations and provinces.

Canada has been given 68,471 square feet of space in the various buildings, exclusive of space yet to be granted in the agriculture and live stock departments.

Bond & Co., 576 Rookery, Chicago, will send, postpaid, on the receipt of 50 cents, a 400 page advance guide to the Exposition, with engravings of the grounds and buildings, portraits of its leading spirits, and a map of the city of Chicago; all of the rules governing the Exposition and exhibitors, and all information which can be given out in advance of its opening. Other engravings and printed information will be sent subscribers as published.

The Maryland's World's Fair Board says in its report to the Legislature, asking for an appropriation of $100,000: "It has been suggested by his Excellency the Governor, and the suggestion has met with much favor, that the old Senate Chamber of the State House be reproduced in our building, and that a group of 32 figures be made to represent the surrendering by Washington of his commission, which took place in that historic hall."

Lieut. Baker, of the Marine Section of the Department of Transportation, has secured a promise from the Detroit Dry-Dock Co. for an exhibit of a perfect model in stucco of the entire shipbuilding plant of the company, both at its Detroit and Wyandotte yards.

Mr. Ossian Guthrie, of Chicago, and other scientists, declare that no more striking proofs of the glacial epoch exist in this country than are seen in the Desplaines valley, between Chicago and Joliet. For educational reasons Mr. Guthrie advocates the making of an exhibit demonstrating this fact at the World's Fair, with maps, surveys and collections of geological specimens, which are abundant, so arranged as to show the lines of glacial progress. This, he estimates, would require about $10,000.

Washington, D. C., and Return.

The Nickel Plate will sell excursion tickets to Washington, D. C., and return, via Buffalo, Harrisburg, Philadelphia and Baltimore, on Monday, April 18, at very low rates. Tickets will be good returning until April 28th. Holders of excursion tickets have option of returning direct via Baltimore and Harrisburg, or via Baltimore and Philadelphia, with privilege of stop-over at both places within the limit of the tickets.

Privilege of returning via New York within the limit of the tickets will also be granted, upon payment of a small additional amount to the Agents of the terminal lines at Washington.

Railroads centering in Washington will offer excursion tickets on this occasion, at very low rates, to the many places of interest on their lines; among which the most prominent are Richmond, Old Point Comfort, Petersburg, Norfolk, Mt. Vernon, etc., etc.

Arrangements have been made for reduced rates at the principal hotels in Washington. Through sleeping cars will be attached to this train from Buffalo to Washington.

A better time for a visit to the National Capital could not be selected, the political and social season is at its height, Congress is in session and the galleries of the United States Senate and House of Representatives, as well as other public buildings, are open to visitors.

For rates and other information call on Nickel Plate Agents.

THE production of pig iron for 1891 in the German Empire, including Luxemburg, was 4,452,019 metric tons of 2,205 pounds, as against 4,563,025 tons in 1890, or a decrease of about 2½ per cent., as compared with 8 per cent. in Great Britain and 9 per cent. here for the same time.

HINTS TO ENGINEERS.—IX.

BY EDWIN WOODWARD.

The art of packing the piston and valve rods—for it is an art, and not the mechanical process resorted to by many—if well understood and practiced is one of the neatest accomplishments of an engineer. The very best quality of packing material undoubtedly is the long fibered, clean, fine, and soft Italian hemp. Do not attempt to pack a smooth and perfect rod with the short, lumpy, tow-like stuff sold as hemp, nor the coarse brown flaxy product. In the first place it is impossible to do satisfactory work with it, no matter how skillfully used. In the second place it is ruinous to the rods, unless it be first washed, dried and beaten, to rid it of the sand and grit in it—while the either sodden or brush like nature of it precludes any possibility of elasticity which is one of the chief requisites of good packing. In former times the hemp after being freed from the woody particles that sometimes cling to it, was invariably braided into gaskets, before put into the stuffing box. It was a part of an engineer's education, to learn to braid readily and quickly gaskets consisting of three, five, seven, and more strands, and when completed put into the stuffing box and the gland screwed down. That is largely done away with now, the fiber being put in quite loosely having care that it is evenly done—no butted ends lapping. The strand is better if cut long enough to fill the box entire. It should be untwisted and inspected for sticks or bunches, and if the length is so great as to be troublesome it should be wound into a ball, and so being is tractable, and can be payed out as needed. Care should be taken not to draw it tightly around the rod, by this means it will not nearly fill the box, besides making much friction, and when loosely filled, screw down the gland to compress it. Repeat the filling till full, screw down the gland finally, and slack up the nuts again, then after the engine has made a few revolutions, tighten the nuts up with the thumb and finger which is all that is required—in its present elastic condition—to make the packing steam tight. It should be regarded as an evidence of very poor work somewhere, or something mechanically wrong, when an eighteen inch wrench or crowbar is needed to aid in adjusting the gland sufficiently to hold steam. In truth, these parts require as delicate attention as your sweetheart, and for success as skillful treatment.

Square rubber packing, which is made of alternate thicknesses of canvas and rubber strips, or the round packing made of cotton fabric with a rubber core, is undoubtedly more easily applied and a surer success with the beginner.

It should be used—the square—with the edges of the fabric to the rod, and should be prepared by cutting off the end first inserted at an angle, whose length will once reach around the rod. After winding the box full the outer end of the packing should be cut off flush with its face.

If it is now removed, the length of the section may be measured and other pieces be prepared at leisure. The round should be cut the same as the square. It is best to test all new and untried packings with a sharp knife before using upon a good rod. If it dulls the knife in a way that shows grit present, discard it at once. It will wear the rod as well.

In the ever recurring round of duty—whose monotony eventually becomes irksome to the young engineer—there always occurs at some time an incident which varies the routine—a slight squeak, the rattle of a loose nut, a knock or jar, indicates that something is wearing or has become loose. If a slight noise is scarcely to be discerned by the beginner in the swish and rush of the fast-moving engine, it is much more difficult to locate the place of the disorder, and, in attempting to solve the problem, it is well to bring to the aid the most ready resource—the law of cause and effect.

It may not be improbable that the theories advanced to account for the trouble may all be wrong, at all events the knock is usually found after looking everywhere else. But it should not be inferred from this that it is good policy to seek the trouble in a quarter at variance with pre-conceived ideas. It is logical and reasonable to begin where the secret is thought to be hidden —following up the various clues that branch from that center till the culprit is at bay and an immediate surrender is achieved.

But what causes a knock? This interogatory is very frequent and the reasons equally numerous. Some few will be alluded to, and from their trend it is surmised that many others may be as quickly located and removed as their presence may be easily detected.

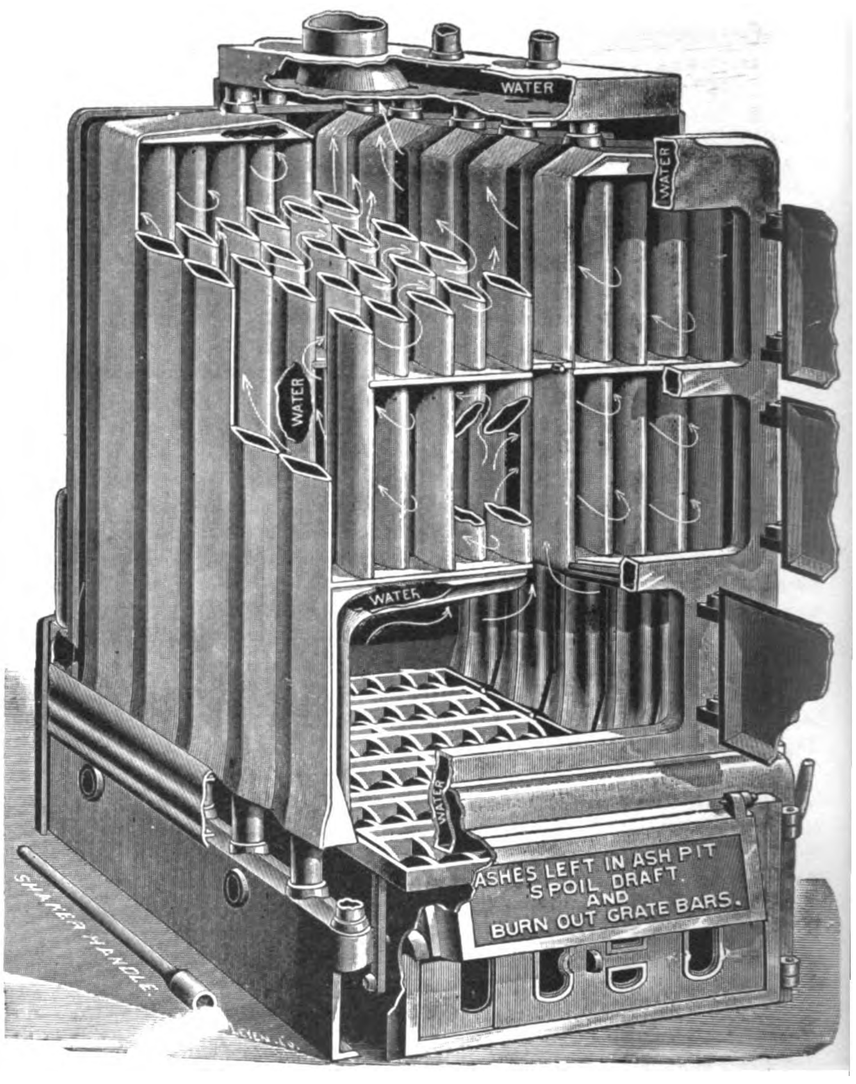
The first that is liable to be noticed is the gland that holds the piston rod packing in place. It not unfrequently occurs that one of the nuts holding it to place becomes loose and runs back a thread or two on the stud. When it does, the gland will pulsate in and out at each stroke of the engine. On its backward stroke it strikes the packing, and will leave no sound, but when it swings the other way, it will come in contact with the nut, and the result will be a click at every revolution. If tightening the nuts will not stop it, it is probable that the packing is old and inelastic. In that case a new suply is needed. If the engine when coming under your care was running smoothly, this should be conclusive evidence that the fault is with yourself, not the engine, if it fails to perform in the usual satisfactory manner.

But often, when taken first in hand, an engine is found in execrable condition—pounding and hammering at every stroke, and any attempt to tighten up the brasses, pillow block cap or quarters will be followed by a rapid heating of the journals, smoke, fire and destruction follow, if persisted in, and realization of the fact that something is wrong is forced upon the mind of the engineer. If but one or two bearings exhibit unruly tendencies, examine them carefully to discover the cause. If they have been keyed up too snugly, it is probable that the journal and brasses are abraided. In this case it will be impossible to secure good results till the bearings are smoothed up. After having trued them up, the best limited experience will admit of, run a trifle loosely for a few days, adjusting a little each day, till the knock is gone. But if it cannot be so removed decide at once that the wrong horn of the dilemma has been grasped. It is probable that the engine is out of line, and assuredly so if none of the bearing run well, then the only way to secure satisfactory results is to give the engine a thorough overhauling and lining up. This comes within the jurisdiction of the erector, but he having failed to make it stable or its foundation having given away, it falls to the lot of the engineer to correct the errors, whatever they may be. In so much as it is a good opening for valuable mechanical education the engineer hails with pleasure the first opportunity to prove his theories by experience. An individual who has sufficient activity of mind to invent or apply theories to account for phenomena or conditions of matter, is of necessity quite conspicuous when contrasted with the chump who accepts good or evil as a matter of course nor makes any inquiry of its cause.

The former is the man who will make the useful engineer, no matter if he is at times a little extravagant with his fancies. He will attempt to make himself familiar with the work of lining an engine, and as aids to his efforts the fundamental principles of the art will follow:

A NEW HOT WATER HEATER.

We show herewith a broken-out view of the new Capitol hot water heater, whose manufacturers claim for it that it is one of the handsomest heaters made; that it takes up little room, and that it heats water hottest and quickest, and keeps it hot with the least fuel. Practical men, having an expert knowledge of the requirements in such apparatus, are quick to see wherein lies its efficiency and its economy. It is easy to handle and quickly set up. It has few water joints, and they are screwed together, all metal, and all are practically outside the heater, away from the action of the fire and accessible for any necessary tightening without disturbing the fire, or even opening a door. If a section should get broken it can be shut off and the heater used until a new section can be put in, when the change can be made without disturbing the piping or the other parts of the heater.


WATER
WATER
WATER
WATER
WATER
ASHES LEFT IN ASH PIT SPOIL DRAFT AND BURN OUT GRATE BARS.
SHAKER HANDLE

Full particulars will be given on application to the Capitol Heater Co., Detroit, Mich.

The Ancient Order of Hibernians of America.

The next bi-annual meeting of the Ancient Order of Hibernians will be held at New Orleans, La., May 10 to 16. Arrangements have been completed whereby the Queen & Crescent Route will run solid vestibuled trains through without change, leaving Cincinnati on Sunday May 8th. On the return trip arrangements have been completed to give all an opportunity to stop over one day at Chattanooga to visit the famous Lookout Mountain and Missionary Ridge, the schemes of the decisive conflict during the late war.

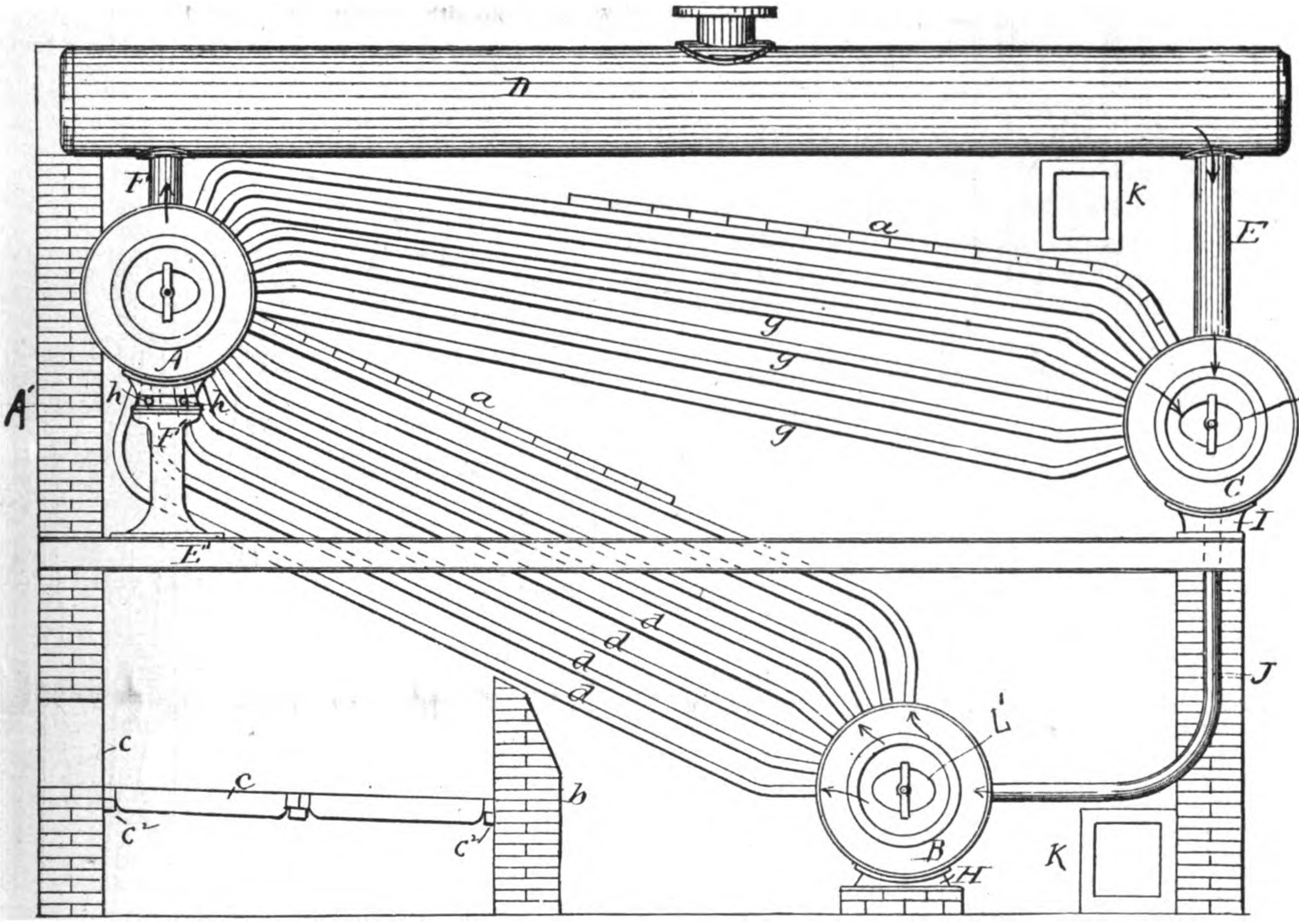
See that tickets read via Queen & Crescent Route from Cincinnati. Sleeping car berths from Cincinnati can now be secured on application to D. G. Edwards, G. P. A., Cincinnati, O.

THE Lodge & Davis Machine Tool Co. Works, Cincinnati, have just opened a new machinery store in Cleveland, O., at No. 32 South Water street, for the exhibition and sale of their improved machine tools. They will carry a complete stock of their latest designed and most improved tools, and will be prepared to give quick delivery as the growing trade of Cleveland and vicinity demands. Call and examine their machinery.

ZELL'S IMPROVED WATER-TUBE BOILER.

A continuous circulation, avoiding the burning out of parts, due to the deposit of sediment on the inside, is one of the prime objects of the invention of Robert R. Zell, of Baltimore. The inventor, also, had prominently in mind the securing of a large heating surface, increasing the circulation and rapidly generating steam. In the cut is shown a side elevation of the boiler with the side furnace wall omitted, so as to show the arrangement of connections of the various parts of the boiler.

Within the furnace walls A′ there is arranged a water tubular boiler consisting of three cylindrical water drums A, B, and C, arranged sidewise to the furnace. The drum B is connected to the drum A by means of the curved inclined tubes *d*, and the drum A is connected with the drum C by means of the curved inclined tubes *g*. The tubes *d* and *g* are arranged in rows across the furnace and in each row are parallel to each other, and in each row are located above the spaces between the tubes in the row beneath, thereby forming a staggered arrangement of the tubes, by means of which a large heating-surface is exposed to the fire, which is broken up by the staggered arrangement of the tubes. From the drum C several pipes J extend downward to the drum B. The steam-drum D is connected to the drum A and the drum C by the pipes F and E, respectively. The drums A and C are supported on horizontal wrought iron beams E′, the drum A by a rest F′ and rollers *h h*, and the drum C on the saddle I. The drum B is supported on the saddle H, resting upon suitable brick-work in the bottom of the furnace.



ZELL'S IMPROVED WATER-TUBE BOILER.

The furnace is of the ordinary construction and is provided with the grate *c*, resting upon suitable supports c^2 in the front furnace wall A′, and a bridge wall *b*. *c′* represents the opening through which the fuel is introduced to the grate *c*. Deflectors *a a* of fire-brick are arranged above the upper series of tubes *d* and *g* and serve to deflect the products of combustion around and through the tubes, compelling the products of combustion to take a circuitous route, thereby exposing a large surface to said products of combustion, by means of which the water is rapidly heated, a perfect circulation is produced, and steam is rapidly generated.

The operation of the boiler is as follows: The feed water is introduced into the drum C by means of the pipe M, provided with a valve *m′*, and being heavier than the heated water in the boiler descends through the tubes J into the lower cylindrical boiler drum B, which acts as a water leg and mud drum or separator. The tubes *d* enter the sides of the said water drums radially or at a line drawn through their centers. The circulation of the water will be across the drum B, as shown by the arrows, and upward through the inclined tubes *d* into the water drum A, and from said water drum the water can return either through the inclined tube *g* to the drum C to mix with the incoming feed water, or may ascend through the pipes F into the steam and water drum D, the water in the said steam drum descending by means of the pipes E, where it mixes with the feed water introduced into the drum C, and the circulation of the water continues in this manner around and through the various drums and tubes. The facilities for cleaning the boiler are excellent, as by the construction above described the deposit takes place in the drum B, from which it can be easily cleaned out. The construction of the boiler also admits of many boilers being set up in a continuous battery, as they can be cleaned from the ends and top instead of the sides.

The inventor's chief claim is on the combination of a mud drum, cylindrical water drums at the front and rear of the furnace arranged above said mud drum, with one series of curved inclined water tubes connecting said mud drum and the front water drum and another series of curved inclined water tubes connecting the front and rear water drums, a feed pipe entering the rear water drum, and a steam and water drum connected to the said water drums, said water tubes entering the drums at a line drawn through their centers.

The patent is assigned to the Campbell & Zell Co., of Baltimore, who manufacture the boiler.

Interesting Test of Rival Boilers.

A boiler test that was carried on with even more spirit than usually attends such competitions, was made February 21 and 23, in the power house of the Rochester Railway Co., of Rochester, N. Y. There are in position in the boiler room of the power house of the Rochester Railway Co. four Heine boilers, rated at 200 H. P. each, and one Babcock & Wilcox boiler of the 12-high type, rated at 416 H. P. The steam generated is supplied to high-speed engines to operate dynamos furnishing electric current to operate the electric railroad lines of the railway company. The tests were under the direction of Chas. E. Emery, Ph.D., a New York engineer, and Prof. M. E. Cooley, director of the department of Mechanical Engineering of the University of Michigan.

Something of the conditions under which the tests were made is indicated by the following extracts from the agreements signed by the two companies. "The boilers to be tested to be preliminary operated with a bright fire until properly heated up—the water level in boiler noted, when boiler and feed pump are operating under average conditions; the pump is then to be stopped and fires promptly hauled. A new fire to be immediately started with weighed kindling and coal on bare grates, and the beginning of the test to be noted at the time such fire is started. The duration of the test to be ten hours as nearly as possible. At the finish the water is to be brought to the same level as when fires were hauled at the beginning, and while the boiler is still steaming and pumps running regularly, the pump is to be stopped, the test closed and fires immediately hauled. The firemen of the Babcock & Wilcox boiler to cease firing not more than 9 hours and 40 minutes from the beginning of the test, and those of the Heine boiler not more than 9 hours and 50 minutes from the beginning of the test, except that such firemen may, with the consent of the experts, fire small quantities of coal to maintain fires during the portions of the test not completed, it being the intent to maintain the fires at the highest temperature which will permit their being hauled promptly at the expiration of the test limit."

The Ideal Drawing Stands.

W. S. Rogers, has disposed of his line of drawing stands to M. C. Hammett of Troy, N. Y., who will continue their manufacture and would be pleased to have the same encouragement that was so cordially bestowed upon Mr. Rogers who remains as Superintendent of the works.

Are You Going West?

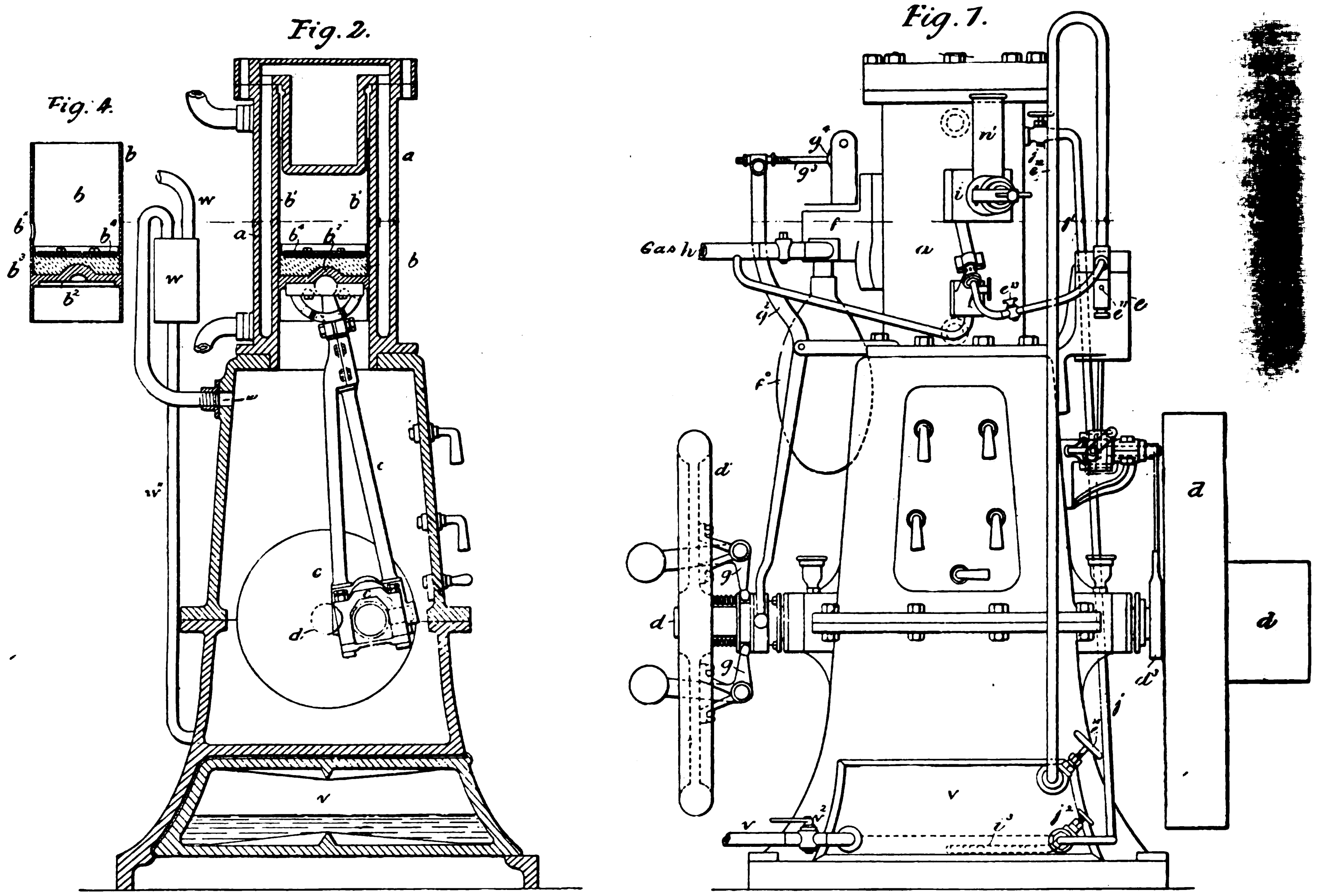
If you are, do not fail to improve the offer made by the Nickel Plate, whose Agents will sell excursion tickets to Omaha, Neb., at special rates, account the Conference of the M. E Church to be held at that point during May.

Half Rates to Omaha.

Nickel Plate Agents will sell excursion tickets, account the Conference of the M. E. Church to be held at Omaha, Neb., May 1st to 30th, at greatly reduced rates. Full information given upon application.

THE DAWSON GAS ENGINE.

Henry Thomas Dawson, of Salcombe, Eng., has secured a patent in this country on a gas engine, of which two illustrations are presented on this page. An improved gas engine, suitable for high speed, has four stages in its cycle of action. First the cylinder takes its charge during the outward movement of the piston; second, the charge is compressed by the return of the piston; third, the charge is fired and the effective outward movement of the piston takes place, and, fourth, the products of combustion are discharged while the piston returns. This cycle is attained in the Dawson gas engine without the use of valves or slides, the piston itself operating as valves, and, besides reciprocating, it entirely revolves once for each cycle of the engine.



THE DAWSON GAS ENGINE.

Fig. 1 in the annexed illustration is a front elevation; Fig. 2 is a vertical section. In both, a is the cylinder. It is water-jacketed to keep it cool. The cylinder contains a piston b, which, by a connecting-rod c, drives a crank on an axis d; d' d' are fly-wheels, and d^2 is a belt-pulley; d^3 is an eccentric on the axis actuating an air pump e, which supplies the jet of air for forcing the furnace. f is a casing containing a valve which opens for the admission of air and gas to the cylinder. f° is an elastic bag serving to maintain a uniform gas-pressure. g is a governor controlling the gas and air supply. h is the gas-supply pipe. i is the ignition apparatus. k is the exhaust or outlet from the cylinder. The crank and connecting rod are enclosed in a chamber and a lubrication is effected by oil or lubricant being placed in the crank-chamber and distributed to the main working parts by the motion of the crank. The piston is tubular and about twice the length of the stroke. The piston tube b' is closed by a diaphragm b^2, located at about the fourth of its length from the outer end of the tube. The inner face of the piston diaphragm b^2 is covered with asbestos or other non-conducting material, b^3. The cylinder is about three times as long as the stroke. It has long ports about its center part. These ports extend spirally in the cylinder walls for somewhat less than the length of the stroke. The cover or upper end of the cylinder a is made to extend into the tubular piston, as is seen in Fig. 2, so as to leave only a proper space for compressing the charge. The cover contains water, and water-passages are formed upon the cylinder, the whole being in connection with a cistern. The water is admitted from the cistern at the bottom of the jacket and flows out at the top to return to the cistern, and so a continuous circulation is maintained.

The heating of the furnace-chamber and the capsule when at work is performed by the combustion of gas, which enters by a regulating-cock. It enters a tube and is urged forward by an air-blast. The gas and air mixed together pass on into the furnace chamber, where they burn. The ignitor is started by holding a light at the top of the chimney.

This construction and arrangement of igniting apparatus insure certainty of ignition. This results from placing the open end of the capsule near to the charge to be fired. The blast keeps the capsule in a state of incandescence and causes a great intensity and rapidity of ignition necessary for high speed. The inventor has also made provision for starting the engine without the use of the air pump. The claim made for the new engine is in brief, the combination of a cylinder, a piston, means for reciprocating and continuously rotating the piston, ignition apparatus, and entrance and exhaust ports controlled by the piston, whereby, by the action of the piston, the form-fold operations embraced in the engines cycle of action are performed, as outlined in the opening paragraph.

Western Travel on the Nickel Plate.

Numerous letters of inquiry for information relative to rates and routes to the West, received at the Central Ticket Office of the New York, Chicago & St. Louis Railroad, in Cleveland, O., indicates an increasing desire to seek homes in some of the new States recently admitted into the Union. With fully matured State governments, those of our people who contemplate a future home in the Great West, feel a greater confidence in investing than was felt under their uncertain futures as territorial governments.

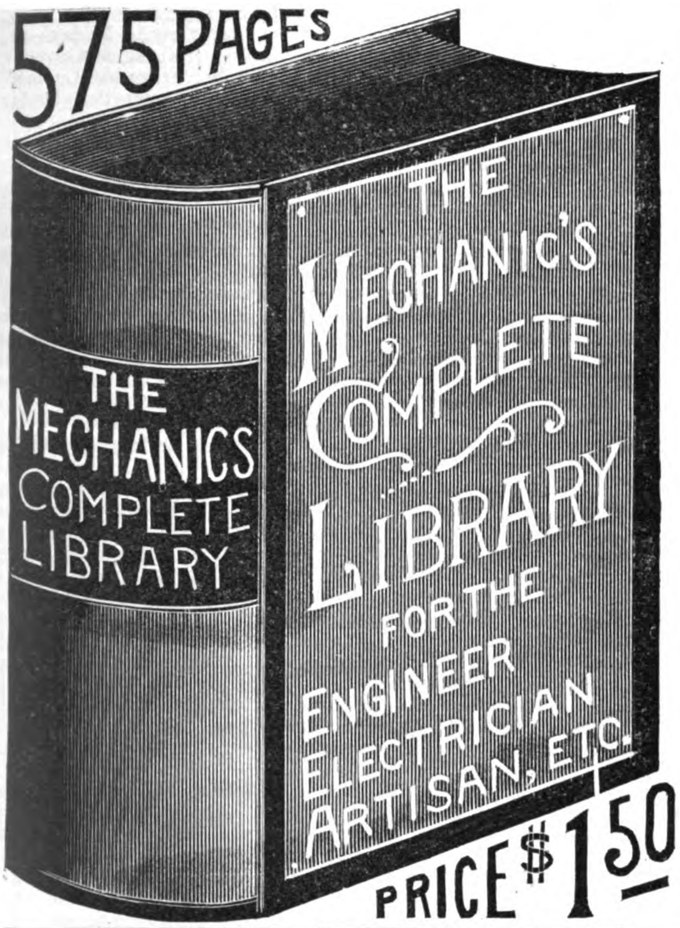
North of Utah and south of the British Possessions the entire distance from the Atlantic to the Pacific oceans may be traversed within the boundaries of free and independent States of the American Union. In any of these west of the Great Lakes fertile farming lands may be secured at a nominal cost, and with the almost innumerable towns and cities which from year to year spring into opulent existence as if by magic, it is a matter of no surprise that many of our most energetic and ambitious citizens become restless and dissatisfied in our overcrowded communities, and aspire to enjoy the advantages offered not only to the agriculturist or stockman, but in almost any of the branches of industry which spring into successful and permanent existence wherever the plow point is entered, or the miner's pick lays bare the manifold treasures of the earth.

Special care has been taken to supply all ticket offices of the Nickel Plate with maps and printed information of interest to those contemplating a home in any part of the West, and also their facilities for ticketing passengers and checking baggage to any point in the United States, Canada or Mexico, are ample. If the information desired is not in possession of the agent when called for, the same will be procured at once, and by telegraph if necessary. Special advantages in rates may be secured at any time by consulting agent of the Nickel Plate.

Passenger Fares Reduced.

Frequent reductions in fares for the round trip seems to be the order of the day at present. In the Northwest or West, the news of the wonderful yield of cereals, or some recent development of the vast mineral wealth, sends a thrill to the feelings of the average citizen; or in the Southwest or South, some marvel of progress in the new industries so rapidly developing, calls strongly upon the speculative instincts.

Circulars and other information of all reductions are constantly in possession of the principal agents of the Nickel Plate. If inquiry is made of any agent of the Nickel Plate not fully informed on the subject, the information will be procured at once, and by telegraph if necessary. Tickets of any class on sale and baggage checked to any destination in the United States, Canada or Mexico, at lowest rates.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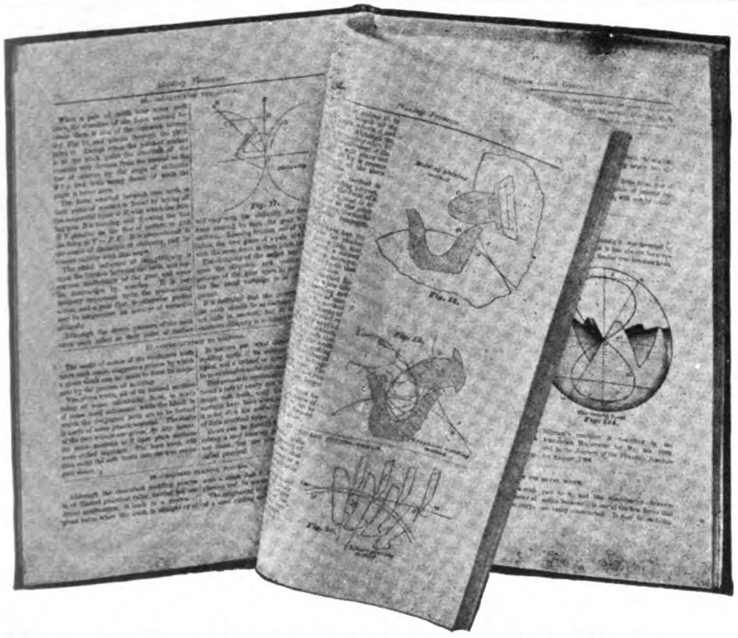
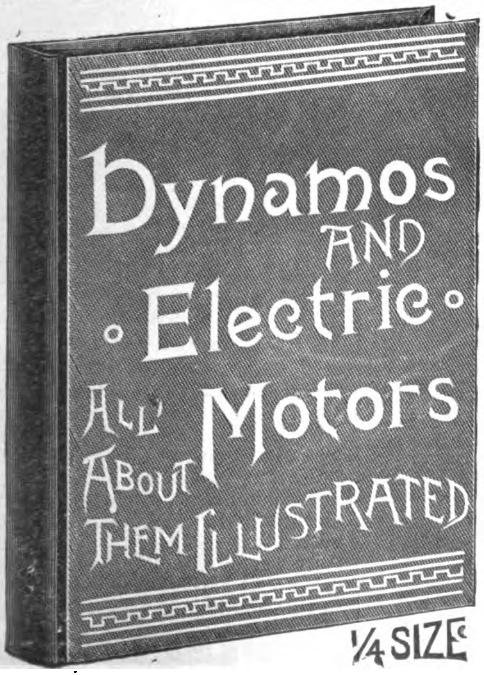


Odontics, or The Theory and Practice of the Teeth of Gears.

This work is by Geo. B. Grant, is 9½ by 6¼ inches square, has over 100 pages and 163 engravings. The quality of the paper, printing and cloth binding is unusually fine in a book of this price—$1.50. No mechanic having, or liable to have, anything to do with gearing, should be withhut it, and it will pay for itself every day of the year in the room of the draftsman and pattern maker. See additional particulars under "Description of Books."



DESCRIPTION OF BOOKS.

THE MECHANIC'S COMPLETE LIBRARY Is about double the size of the cut in this page. It has 575 pages and some 250 engravings, and treats of almost every subject, like the hand-books of Haswell, Trautwine, Nystrom and others. Immense editions have been sold. It has a vast quantity of matter, and is a very cheap book for its price—$1.50. **With every copy is given free a complete working chart for setting gear teeth.** We can not give a more detailed description, but will, as stated below, refund the money to any one who may think the paper and book not worth $3.

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A SET OF FINE TOOLS.

BY WM. HARRISON.

[Let not the reader whose taste does not run to that which diverts as well as instructs the mind, and who shuns fiction as unprofitable stuff, think that thewill violate his custom by perusing Mr. Harrison's paper. It is essentially rsue, and those who skip it will miss a narrative that substantiates the saying that "Truth is stranger than fiction."—Ed.]

RECAPITULATION.

Charles C. Adams, a mechanical engineer and instructor in a technical school, is reduced by sickness and his bad financial management, to distress. While in these straitened circumstances, a gentlemen, calling himself John W. Ellis, visited him and gave him employment. The work was to make from certain drawings a set of tools, which, Mr. Ellis explained, were to be used in constructing the model of a very important invention. There was to be absolute secrecy. Five hundred dollars were paid down, and as much more when the work was finished. The job took about a week. Ellis set the price himself, and the reasons he gave for paying so much satisfied the maker.

Mr. Adams now had not only sufficient funds to relieve the distress of himself and parents, but was able to develop an invention of his own. He was a most prolific inventor, but only this one patent was commercially valuable. He went ahead with it and in a short time became wealthy. The strain of providing a competence for himself and parents being now eased, he devoted his attention to a young lady, Miss Ludlow, whose hand he asked in marriage. The lady herself was quite willing, but the father was in no haste to accord his consent. On the occasion of the interview between Mr. Adams and Mr. Ludlow, on the subject, which it was expected would be final, the latter produced a pair of long forceps, which had been left behind by a burglar who raided a neighbor's house, and showed the astonished young inventor and manufacturer the name of "C. C. Adams, Detroit, Mich," stamped in the steel. There was no doubt that the instrument was one of the set made for the alleged purpose of constructing a model, nor that Mr. Adams had, instead of handing the blacksmith the stamps furnished him for this purpose by Mr. Ellis, substituted his own for them unwittingly, with the result that his name was on every piece of a large kit of unusually fine and dangerous burglars' tools. He is in an uncomfortable position and can not make Mr. Ludlow believe in his innocence. When suffering the worst from the unfortunate dilemma, he is suddenly introduced to Mr. Ellis, at a party at the Brunswicks, as S. V. Ashton.

A close observer of S. V. Ashton's face would have detected a slight change of shade at the moment he caught sight of Mr. Adams. But he was not thrown into confusion, and before his hand met that of the young inventor he was on his mettle. "It would have been the disappointment of my life to have failed in meeting you this evening," said Mr. Ashton, with charming nonchalance, "I have heard so much of your remarkable invention. Let me introduce you to my friend, Harry Bellknap."

He turned, as if expecting to find that gentleman at his elbow.

"Hello, he must be in the drawing room. I'll fetch him. I'll take an option on you for ten minutes, as I wish particularly to talk with you."

Mr. Ashton found Bellknap talking with a high-up base ball official.

"Harry," said Ashton, taking his chum by the arm, "young Adams, the one I told you about, is in the next room. Now is the time to get in our first work. Be careful in answering his questions. We must give him his way, and it may be a paying streak."

Charlie Adams was taken by surprise if ever a man was. A talk with this individual was just what he wanted. He felt like kicking himself for letting Mr. Ashton slip away so nicely without permitting him to say a word, and when he entered the room again, in company with a small man with black, beady eyes, and a dark, drooping mustache, he felt relieved.

"How are you getting on with your invention," asked Charlie of Mr. Ashton.

"Slowly, but satisfactorily," was the reply. "I wished to ask your advice in regard to certain procedure in connection with the case. There is plenty of that article gratuitously supplied without solicitation, but a very little from one who has become as successful as you have is worth acres of the kind floating around. But I shall call on you—next Saturday, if convenient to you—and lay the particulars before you. I wished to have you meet my friend Bellknap because he has a project under way that ought to be of mutual advantage to you. You can give Mr. Adams some idea of it, Harry, while I bid good-bye to Mr. and Miss Sycamore, who sail for Europe shortly. I see they are leaving."

Mr. Ashton arose.

"Just a moment," said Charlie, talking him by the sleeve, "for fear some one will detain you unexpectedly. I would like to ask you if I can see some of those tools I made for you once. The steel in them is of a peculiar kind. I can get no more where I got that, but a close examination of some of them may enable me to tell what it is. Besides, I would like to put a blue finish on them which I have lately compounded. They were not even decently dressed. Could you fetch over a few—the more the better—when you come to see me about that other matter?"

"Certainly, with great pleasure," answered Mr. Ashton. "I have them all in the experimenting room, and would be delighted to have you put on a blue finish. I will bring them all."

He was off in a twinkling. Charlie felt his pulse quicken and the weight of anxiety on his mind to lighten. If he could but get those little pieces of steel in his hands he would thank Providence to the last of his life. Ashton was either heading him off the easiest way possible, or else he had procured the tools for a really legitimate purpose, and one, at least, had drifted into bad hands. How a burglar could swing in such society Adams could not make out, and the more he thought about it, the more he became convinced of the probable innocence of that dapper gentleman. If he came back and renewed the conversation, the latter supposition would be greatly strengthened. If he did not, it would be his (Adams') duty to secretly advise the Brunswicks of his character, and to denounce him openly, after he had procured those tools—if he ever did.

While these thoughts were going on in his brain, Mr. Bellknap chatted away, his ardor undampened by the preoccupied and non-responsive manner of his interlocutor.

He knew, however, that his hopes were greatly brightened by the reappearance of Mr. Ashton. The behavior of Ashton so far satisfied the inventor that, instead of getting one of his friends to slip over to the nearest station and telephone for detectives to watch and track the suspicious man, he left the house with a light heart, believing that he was soon to be released from the meshes of that unfortunate net. The only incident that he could not completely harmonize with a favorable view of the circumstances, was that of the aliases. But Mr. Ashton had explained that away, in a measure. He had received positive instructions to make such purchases as were necessary, and to open experimental rooms in Windsor, Canada, in the name of John W. Ellis, for good reasons which they could not yet make public. But since they had filed their applications in the patent office, he had no longer masked his identity, and for nearly a year had been going by his right name.

Mr. Adams felt better on arriving at his office the next morning than he had for many days. And when he found in his mail a note from Mr. Ashton begging to change the date of their interview from Saturday to Friday—and distinctly promising to bring the tools—he increased in flesh several pounds. He already saw, in his mind's eye, the clouds disappear from old Ludlow's brow, and he heard the many congratulations of friends over the pleasing announcement of his wedding.

While passing the door of the Superintendent's office, Mr. Adams heard, above the hum and grind of the machinery, which was always music to him, a young man appealing to the gentleman who presided therein to let him stay awhile longer and give him a little more chance to show what he could do.

"You are no machinist at all," said the Superintendent, brusquely. "You may have been able to fool others, but you can't fool us. We have no use for incompetents. You can take your pay with you to-night."

The young mechanic to whom these remarks were addressed turned sadly and walked into the shop. Mr. Adams entered the Superintendent's cubby-hole and inquired what was the matter with the boy.

"He is of no account," was the reply. "He was hired for a machinist who had served his time, but I don't believe he has been at it a year. He has not earned five dollars all the week."

"What does his foreman say of him?"

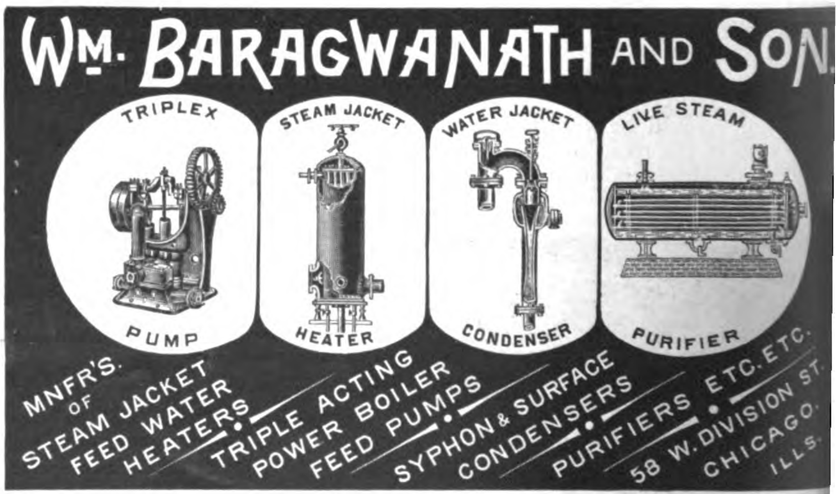
"He says that he is a good, willing boy, and picks up rapidly, but he can not do the work required of him."

Mr. Adams thought a moment. "I'll tell you what I think, James," he said. "The boy has not had proper handling where he worked last, or where he began. A great many foremen use the poorest kind of judgment in giving apprentices their work. They drill them into one kind of work and keep them at it right along, instead of varying it and developing the boy into a machinist capable of doing everything. I have seen that very, very often. They do not do their duty, either by the firm or the boy. They find out that an apprentice excels at certain work and they keep him at it. In order to cover up their mistakes in so doing, they make this young man think that he is schooled enough to procure machinists' wages. Sometimes the foreman is not as much to blame as the firm. It not infrequently occurs that he is not provided with enough good men who can do anything that comes along, and thus he makes a latheman of one apprentice, a planerman of another, a drillman of another and so on, as the easiest way out.

"Now, it might have escaped the observation of this boy's foreman that he is an expert on the boring machine. I passed through the shop the other day and noticed how he did a difficult job. I need not here explain what it was, but it goes to show that he was kept on the boring machine and became unusually proficient at that work at the expense of his general education. That was not his fault. You have done right enough, James, in looking out for the interests of the company by discharging men apparently not available to us. But I would suggest that that boy be kept a while longer. If he is willing and ready, as the foreman says, let's give him a chance to become a good machinist. I do not like to start a boy downhill instead of up. By discharging him now he will get a start in the wrong direction, while if we keep him and give him a chance he will probably pay us back for any temporary loss by taking additional interest in his and our work, in appreciation.

"And, James, there is one thing more," continued Mr. Adams. "We are going to give better wages here. You know we had an argument about it at the meeting of the directors the other day. You know some are opposed to it, and I think you was not entirely convinced of the wisdom of it yourself. The case of the ungrateful and mean man, which Mr. Slocomb brought up, will prove my point instead of his. All admitted that, with average men, it pays to give them enough to make them contented and happy. But the presence of the mean man, they claimed, changes the aspect of the matter. The mean man, they say, will not appreciate anything, is ungrateful as Æsop's snake, and will, while working you for all he can, do you dirt, and will leave you in the lurch whenever convenient. Most of this is true. But the mean man works for money. That is what he is after. Admitting that he will not reciprocate a generous act, because of his unmanliness, he will if there is anything in it. When he knows that it is the policy of his employers to pay a little better than others in order to get and keep a better class of men and to insure the good will of the men, he will be encouraged to do more and better work, *in order to retain his place*, knowing that he could not do as well elsewhere and that there are plenty of applicants for a good job.

"The additional service you get out of him at least repays the extra amount in wages given him, if not more, while the appreciative men in the same shop will pay you a large dividend. It is wrong to deny to one man an advantage just because the one next him may not be deserving of it. As fast as the men prove themselves unworthy they should be dispensed with. After a time



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there will be a shop full of old hands whom you know, and every one personally interested in the success of the firm.

“Yes, James, it pays to give men good wages. How easily they can make 25 or 50 cents more a day, and how often they can, if they have an incentive to please you and to remain with you, save in a few minutes as many dollars as their wages amount to in a week, you know, and every man in the shop knows. We are mechanics, James, and there is no excuse for us to fall into the errors that employers of labor who are not mechanics and who do not know or appreciate the circumstances, fall into. Let us do what we know to be right, and in so doing we will gain rather than lose.”

The superintendent had a talk with Albert Sidney, the boy he was going to discharge, and he remained, but did not know that he was indebted to the president of the company instead of the shop boss for the second chance.

Eagerly did Mr. Adams await the coming of Friday. The possession of the *set of fine tools* would leave no bar between him and the gratification of all his wishes. He could then begin to work out some of the plans he had for the higher development of mechanics—the men themselves and the trade also. And well might the friends of mechanics have wished for him a happy issue out of his perplexing dilemma, for there are too few men who ever concern themselves with the betterment of their fellows and society.

But instead of meeting Mr. Sylvanus V. Ashton and getting back those troublesome instruments, he received, on the following Friday—a blue Friday it was!—a note from the gentleman of the euphonious title which read:

“DEAR MR. ADAMS:

“I am sorry to have to state to you that every one of those tools has been stolen from a shelf in my experimenting room. *And this is not the worst.* I will see you to-morrow and let you know about another unfortunate incident in connection with them. Yours faithfully,

S. V. ASHTON.”

Things seemed to have taken a leap from bad to worse very suddenly, and Mr. Adams was again plunged in water whereof the temperature was at 212°. What could be worse than not getting back those tools? Nothing but a positive calamity.

(To be continued.)

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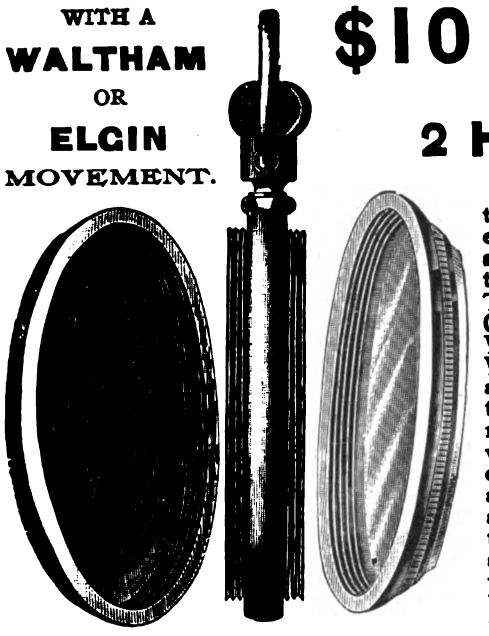

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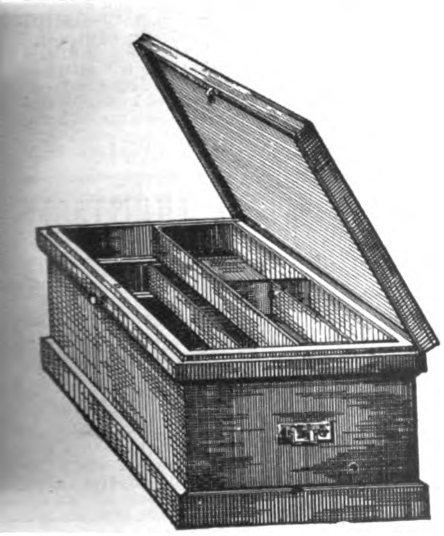

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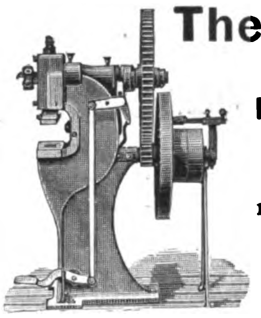

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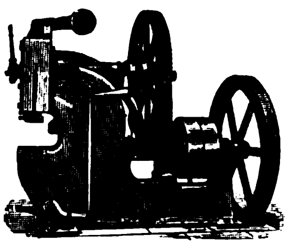

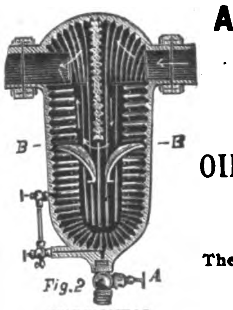

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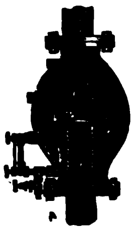

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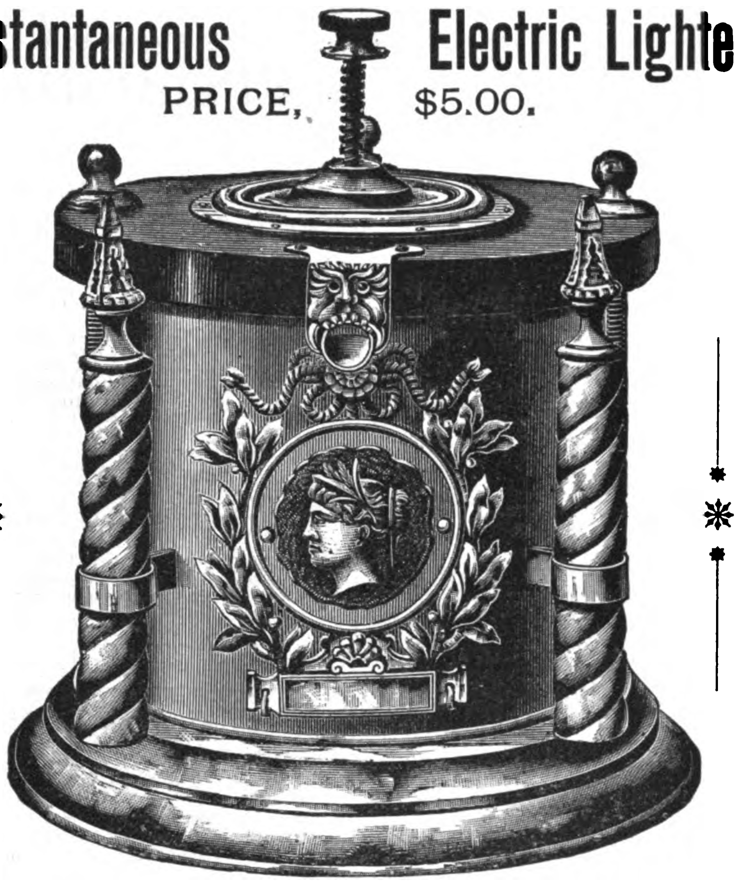

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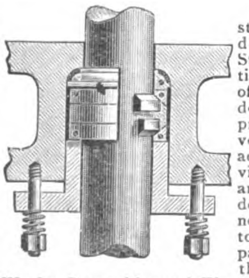

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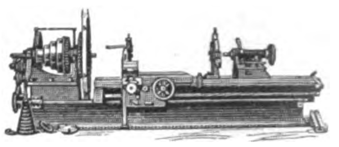

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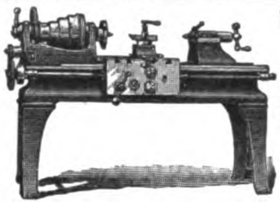

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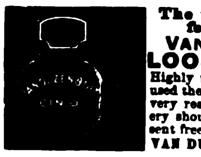

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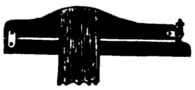

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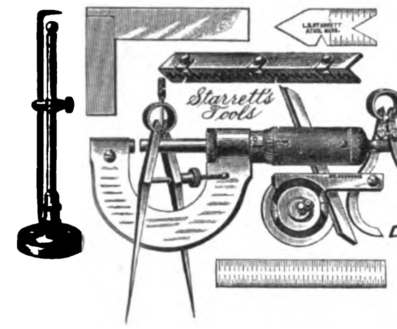

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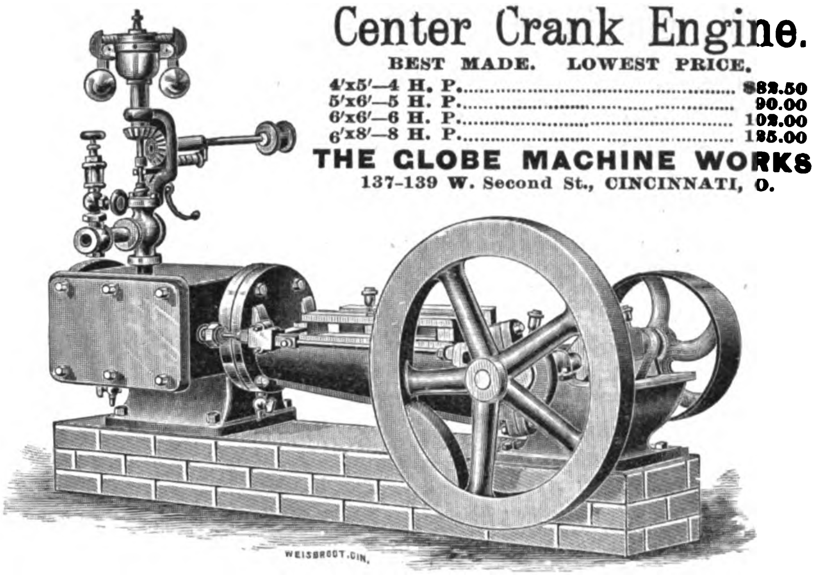
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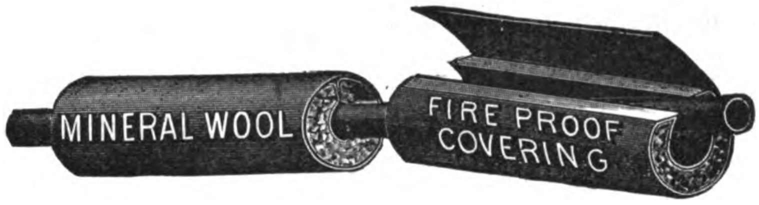

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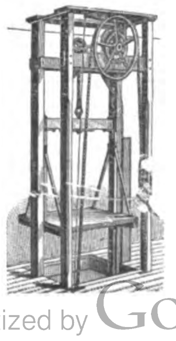

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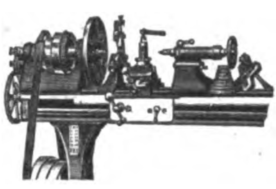

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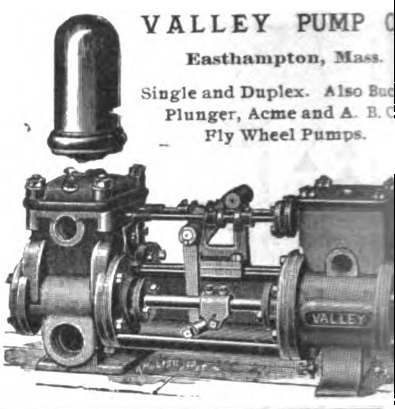

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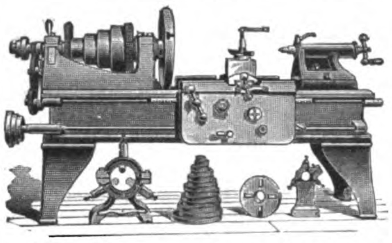

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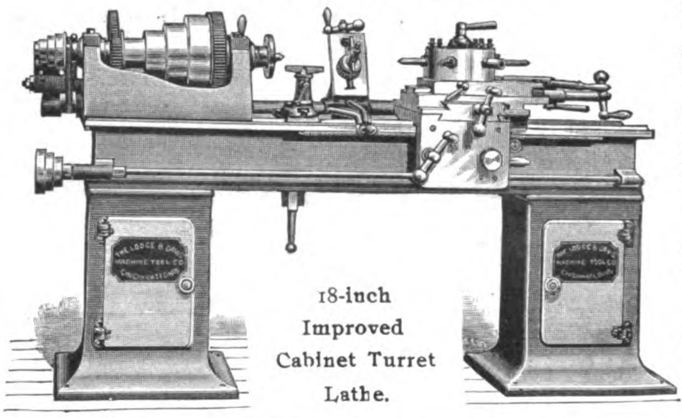
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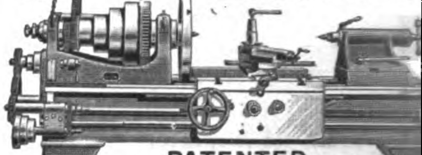

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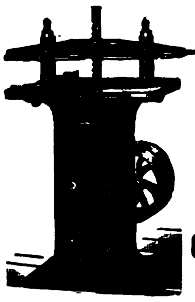

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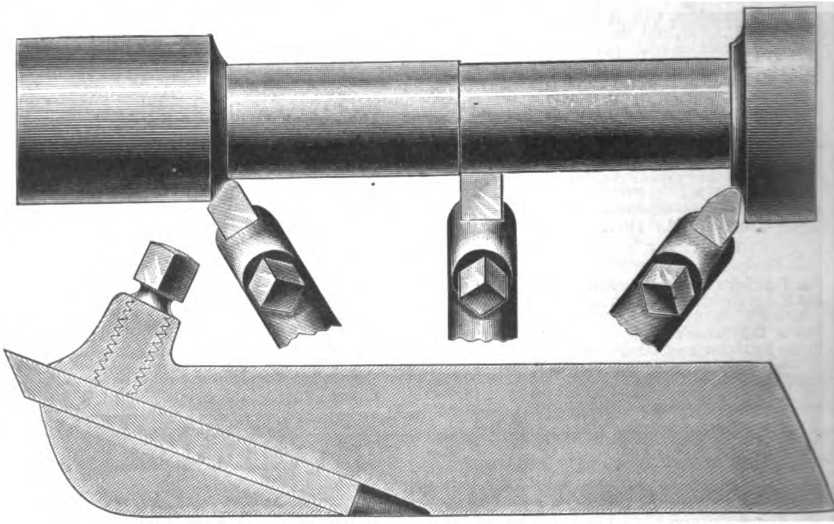

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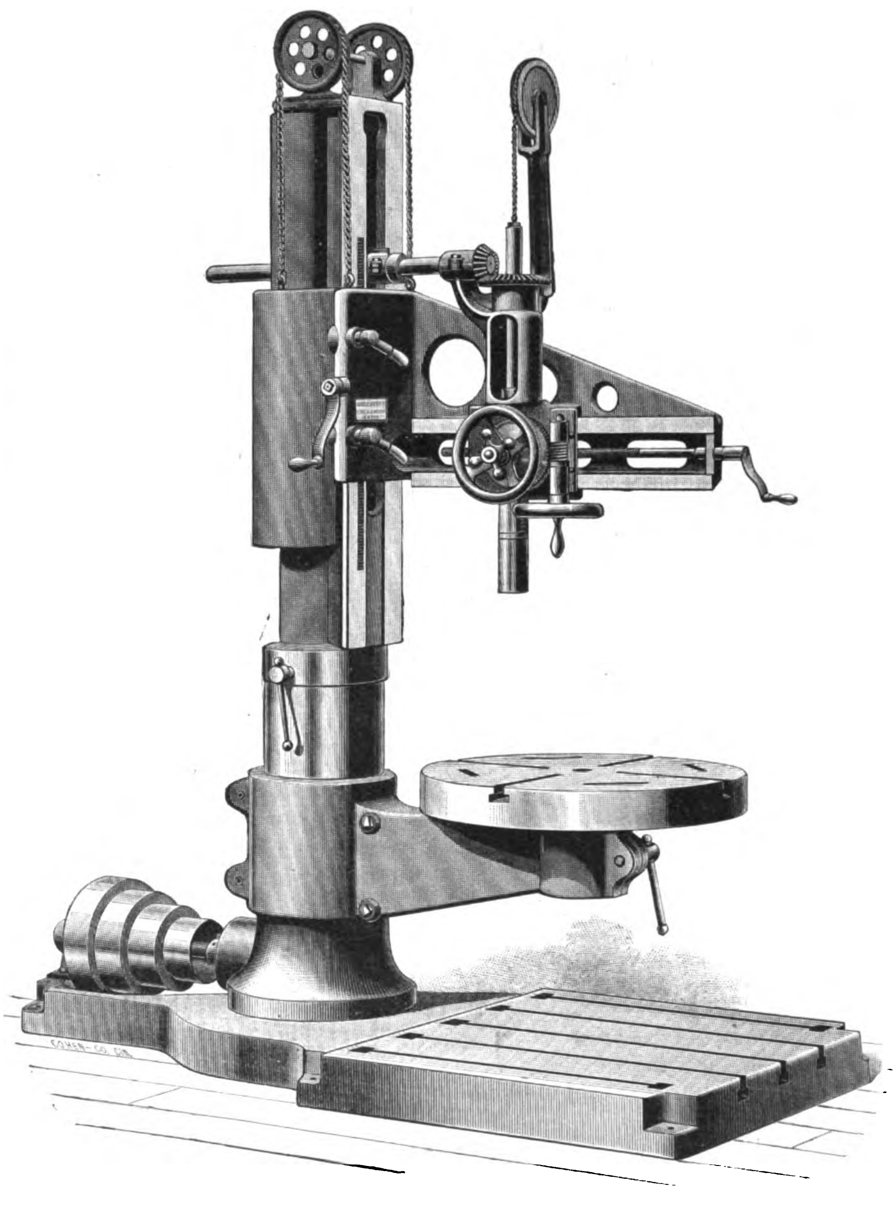
A NEW RADIAL DRILL.

The cut on this page represents a new patent radial drill, provided with the very latest improvements, as well as containing all the commendable features that should be embodied in every first-class tool of this character. This machine is built in three sizes, No. 1 plain, No. 2 back gear, No. 3 back gear and power feed. The one shown is No. 1. The machine is driven from cone pulley as shown on the cut, by means of bevel gears, running one to two, the larger of which driving the vertical shaft through inside of column, connecting with the horizontal shaft by means of mitre gears, cut from solid steel. The horizontal shaft is connected by means of bevel gears, running one to two for driving the spindle. By this gearing the spindle is extremely powerful, the cone running four revolutions to one of the spindle. The feed is very simple, yet powerful, with quick return attachment. The column is made in two parts, the upper one being fitted in a stationary stump which supports the table-arms and table. The table revolves all around the column, and can thus be used in any position. The upper column supporting the gibbed arm with spindle head, has full circular movement, depending, however, upon the position of the driving belt. The cone pulley has four speeds, the largest being 12″, the smallest 6″, all for 3″ belt. The machine is thoroughly balanced by weights on side of column, thus enabling the operator to change the position in a moment's time. All lug bolts have lever attached, doing away with all wrenches. The machine is furnished complete with countershaft. The dimensions given below will show at a glance the impossibility of springing the column, even by the heaviest drilling. Square tables with T slots are furnished instead of round tables, if desired. Diameter of column, 10″; height of column, 6 feet 6″; drillls to center of 52″; vertical adjustment of arm on column, 28″; receives under spindle over base, 4 feet 4″; receives under spindle over floor, 4 feet 9″; height of table from base, 20″; size of table, 30″; adjustment of table arm on lower column, 8″; diameter of spindle, 1 9-16″; spindle bored to fit Morse taper, No. 3 or 4; traverse of spindle, 9″; size of tight and loose pulleys, 12″; speed of countershaft, 360 revolutions; width of belt for cone pulley, 3″; floor space for base, 3 x 6 feet; weight of machine, about 3,100 pounds. This machine is made by Dietz, Gang & Co., manufacturers of machinists' tools, 56–58 Plum street, Cincinnati, O.



A NEW RADIAL DRILL.

A Girl Explains How an Engine is Made.

Power gives the following as a young lady's description of how a steam engine is made—according to the study she made of the subject on a recent visit to the Payne Engine Works, Elmira, N. Y.: "You pour a lot of sand into a box, and throw a lot of old stoves and things into a fire, and empty the molten stream into a hole in the sand, and the men all yell, and it's awfully dirty and smoky. And then you pour it out and let it cool and pound it; and then you put it in a thing that goes round, and try to break it; then you screw it to a thing that goes back and forth, that you can ride on, and that scrapes it and it squeaks; then you put it in a thing that turns it round, and you take a chisel and cut it; then you put it in a thing that bores holes in it. Then you screw it together and paint it, and put steam in it, and it goes awfully; and they take it up in the drafting room and draw a picture of it, and make one of wood just like it. And, oh, I forgot—they have to make a boiler. One man gets inside and one gets outside and they pound just terribly; and then they tie it to the other thing—and oh, you just ought to see it go!"

Scientific Notes.

One of the most notable mechanical achievements of late is the great pulley which has been placed in the mill of the Willimantic, Conn., Manufacturing Co., for transmitting power from the mammoth engine of that plant. This pulley weighs 70 tons, is 28 feet in diameter, and has a face nine feet across; it is cast in twelve sections, each section carrying a spoke and a segment of the rim, the latter being backed in its casting by what is technically known as rib work, in appearance resembling a series of heavy iron panelling. Including the hub pieces, there are 26 parts to the wheel. The spokes alone weigh 36,000 pounds, the rim alone 96,000, and the bolting together of the sections is by a series of 180 2½ and 2¼ bolts. The power from the great engine is distributed from this pulley by three bells, one about 49 inches wide and two of 24 inches width each; the wheel makes 60 revolutions per minute, the surface traveling exactly one mile in that space of time. The shaft which this prodigious pulley hangs upon is some 21 feet in length, including the disks at either end, and of itself presents the enormous weight of 27 tons.

The exhibition at Glasgow, Scotland, of Mr. Mills's new method of propulsion for marine craft has been extensively described, and would appear to be not dissimilar in its main feature to what had previously been proposed in this country. The plan consists in the placing of the propeller at the bow instead of the stern of the ship, this change from the usual construction being made by the inventor in view of what he regards as two legitimate considerations—first, that the revolution of the screw propeller in its ordinary position at the stern of the vessel produces a vacuum, which must be filled by the inrushing water ere the ship obeys the forward impulse, and second, that the water at the bow of the ship offers resistance to its movement. Concluding, therefore, that the propeller should be placed at the bow, the plan in this case is that the shaft is carried through the bow, bearing a conical propeller with a diameter nearly as great as the beam of the ship. The outside of the cone consists of webs projecting at right angles to the surface, and arranged in a spiral, the action being thus a boring action.

A much-needed invention has lately been brought to notice in London and received the commendation of the press. It consists of a simple and inexpensive device for automatically shutting off the gas when it has been blown out instead of being turned off in the usual way. The principle upon which this mechanism is based is the expansion and contraction of a metallic loop made of German silver and steel, which is adjusted very close to the gas flame. One end of the loop is free, while the other is secured to the fixture; a valve containing the gas is attached to the free end, and, when the gas is burning, the valve is open and the gas freely escapes. If, however, the gas is blown out, the property of the loop is quickly to cool and contract, and the valve will shut off the gas. The device is said to respond promptly to the change in temperature, caused by the gas being blown out.

BOLTS AND SCREW THREADS.—VI.

BY EDWIN WOODWARD.

In forging a bolt to be finished in the lathe it is very important to have enough stock to work up perfectly. The length may be close to the requirements, but unless the forging is carefully done the head should be in excess of the diagram, if the body of the bolt is right, for it seldom occurs that they are both central. If not, centre up by the part running closest to the size. However, it is better to have the head close to size, and the body of it larger than needed, as the lathe affords the most rapid means of removing metal.

After receiving the bolt from the blacksmith, and centering, the first business is turning up the ends—both of which are customarily made rounding now—the head being somewhat less so than the point—till the bolt is of the right length. If many bolts are to be made, a great saving of time and patience is made by having a driver, constructed similar to Fig. 13—two views given—to bolt fast to the face-plate, and this does away with the customary dogging. It is a very good method and quite rapid, when bolts are of one length, to run in at the head with a cutting off tool, till the diameter of the bolt is reached. If the tool post has a stop to it, much measuring is dispensed with by setting it to this size, duplicate sizes of the rest are assured by the stop, and if the carriage is secured against lateral motion uniformity in length is also secured. It is true that the heads of bolts may be made smaller than the nut and still have sufficient strength, although if both are of one size, a wrench to fit one end will fit the other.

As the center of the bolt must be the center of the head, it is evident that it cannot be larger than twice the distance from the center to the nearest face, and for ordinary work, if the head equals twice the diameter of the bolt it is too large for symmetry, one and three-fourth diameter being ample and on larger bolts less is better proportion. For cap screws and bolts where their frequent removal is necessary too small a head is objectionable, for the reason that the corners wear off too soon and is so rendered useless. The length of the head should equal the diameter of the bolt. Figs. 14 and 15, show respectively the square and the hexagon, of true proportions. The thickness of the nut when finished, should measure the same as the diameter of the bolt. Its width on quarter inch bolts is twice the diameter, or one-half inch decreasing gradually as the bolt increases in diameter to one and five-eighths on the inch bolt and larger.

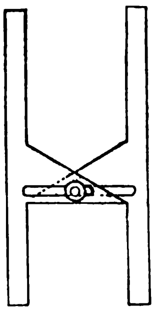


Fig. 17.

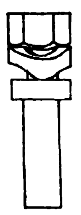


Fig. 18.

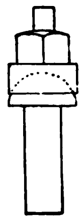


Fig. 19.

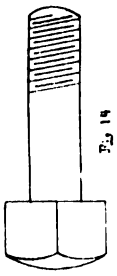


Fig. 14.

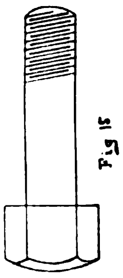


Fig. 15.

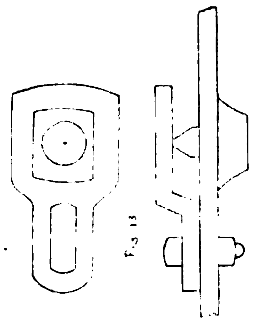


Fig. 13.

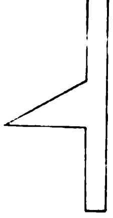


Fig. 16.

Much more work is necessary to get a fair result on a nut than on a bolt. In the first place, no material progress can be made without one or more special tools. The first and most important is a gauge made after the pattern of Fig. 16, of sheet steel No. 14 or 16 gauge. The parallel portion about $\frac{5}{16}$" wide, the triangle 30° and 1½" high, the ends need not project farther than the length of that edge of the triangle against which it abuts. To be of value it should be carefully made, and its value is greatly enhanced by making two at once by having them riveted together—the rivet holes being the extremity of the slot, wherein Fig 17. shows them fastened together by the milled thumb nut. The right angle of the triangle when in line, making on one side a gauge for three sides of a square nut—and the other four sides of a hexagon nut. The right angled part of the gauge is also used face up, the bottom of the nut square with its bore. The applications of the instrument are so apparent that the most indifferent workman will almost intuitively apply it so correctly, that no further illustrations are deemed necessary.

In using this gauge to face up the bottom of the nut, it is necessary that the hole in it be small enough to make a perfect thread when tapped. If it does not, the tap is liable to lead to one side, if extreme care is not taken to start it straight, and then of course the gauge will be misleading if tried against imperfect threads—the bore of the nut and the course of the tap not being parallel, still, with care good results may be obtained. But screw cutting on the lathe is done to obtain better work than can be had by using die stocks or bolt machines—and the best is usually "just right." Then it is in order to fit up the nut to correspond with the bolt—the top and bottom finished off in the lathe—the angles of its sides, if either square or hexagon, made right with the gauge, the sides perpendicular with the bottom—by gauge—and all of equal distance from the bore.

The most ready means of turning up the bottom and top of a nut is by the aid of a nut mandrel which are usually made in two forms, Figs 18 and 19. Of the first the loose collar which serves as a medium to resist the thrust of the nut, and obviate any tendency, any projection or irregularity on the face of the nut has to throw it out of true on a loose thread, is simply a heavy ring, loosely fitted portions of which are filed away, to leave two projections on each side, diametrically opposite. Opposite faces being at right angles. The same means is secured on the other mandrel—by having the collars spherical—the fast convex and the loose concave. This form having more surface, has more friction and will not respond so quickly, and although the results are good, they in a measure lack the uniformity of the former.

The end of the mandrel should not extend quite through the nut, sufficient space being left to finish down to the point of the thread, but if on small work, the lathe center occupies too much space to admit of it, the end of the mandrel that extends through should have the threads turned off to secure the same effect. While a nut thinner than the standard is no often used, thicker ones are frequentltly called for. If this is borne in mind in making the mandrel and it is made suited for the thick nuts, i may also be used for the regular or thin nuts, by placing on before the nu one or more common washers suited to the thickness.

Of the finer intricacies of screw cutting—the error in pitch made by set-over tailstock—the many and elaborate methods of measuring screws etc., etc., it is not within the scope of these letters to deal. Creditable workmanship and uniform accuracy as displayed in practical machine work, is the desideratum. These accomplished, the application necessary to reduce the finer theories and exactions to shop practice, is far less arduous than the labor necessary to bring the apprentice from his first attempts—which nearly always find the scrap pile—to the wide awake and practical machinist whose mistakes are so far apart that one never hears of the other.

IN AND ABOUT THE SHOP.

BY FRED H. COLVIN.

One of the worst misfortunes that can befall a boy who has a taste fo mechanics is to fall in with an old chap who is down on "book larnin'," which means that he is in the same rut that held him when he first went a the business. Under such a master the boy is handicapped from the start and it would be much easier and better if he could be transplanted to some other shop, and start all over again. But, as is perfectly natural, he think that this man is old, has worked at the business for so many years tha what he tells him must be so, and he goes on learning kinks and fiction mixed, with the latter in the lead.

Not that the old man may not know how to dc good work, or that he is not a first-class mechanic, for very often they are of the best, can turn out accurate work and do it quickly, too, but that is not all of any business

No one man can learn all there is about his business, and if he only learns what he sees and does his knowledge is very limited indeed. If he travels around he can pick up much that is useful, but when he reads the trade papers he gets all that he can in the time he has.

Here are the thoughts and experiences of many men, good mechanics and bad ones too, no doubt, but the good mechanic can readily see what i applicable to his needs and so avoid the bad, if it exists. Put the boy i with a man who is an investigator, who thinks for himself in everythin (this does not mean that he does not listen to the advice of others, but tha he weighs the statements he hears in the scale of his own reason befor accepting them as true) and reads, asks questions and tries in every way t acquire knowledge that he does not already possess. In such hands an under such a tutor he will acquire the spirit of inquiry, learn that he mus consult others' writings and counsel in many cases, and also that he mus always hold his mind in readiness to receive new ideas. This characte will be of value not only in the shop, but out of it as well.

If he stays under the first man for a year or so, he will require muc longer under the second type of an instructor than he otherwise would This may seem strange argument, but can be verified in most cases. Unde the first man he will learn to close up like a clam when there is any goo advice floating around. He will become fixed in the idea that what wa good enough for his teacher is good enough for him, and in order to ge new ideas into him you must hammer them in with a club. It is muc harder to unlearn a bad way than to learn a good one. This extends t many cases outside the shop.

Give the boys a chance, and don't nip the bud at the start by puttin them in contact with the class of men just mentioned, for the power o example is more widespread than we imagine. Put them with good men thinkers in more ways than one, and men who can advance as the state o the art advances. In other words, be able to grow as the conditions deman

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A tin roof well painted will not need repainting for 10 to 15 years. If you need any paint i will pay you to send for circular. JOSEPH DIXON CRUCIBLE CO., Mention this paper. JERSEY CITY, N. J.

or warrant the growth. Under this kind of a teacher the boy will have a good start, not only in the mechanical line, but in all lines, for in everything thought is all important.

And it is no less important that the owners, as well as the men under them, should be men of good principle, for the power of example, as before mentioned, has a wonderfully wide influence, wider than we imagine, influencing those whom we never think of. If the boy sees the owner trying to get the best of the bargain in a job, and by that I do not mean earning legitimate profits, but exorbitant profits, he gets the same idea into his head and practices it as soon as opportunity presents. If the owner slights his work or lets it go out improperly finished, the example is set for the boy to follow, and if he does it we should not wonder very much. In later years the owner will grumble if he finds that the boy is slighting his work a little, forgetting that he is only following his example. The inconsistency is apparent to all. When we are condemning the young for being as they are, is it not well to ask if they are not following our example, and if they are, can we blame them as much as we at first intended?

So, when thinking of putting a boy in a shop (provided, of course, he wants to go, for unless he does it is not only useless but an injustice to him to do so), look well to the character of the shop, of the man he is to work with, and be sure that both are good, morally as well as mechanically.

As an instance of the perhaps unthinking dishonesty that is sometimes practiced in shops, will mention a case that came to notice some time ago.

The equipment of the lathe consisted of about six tools, forged into mongrel shapes, and trying to be of use for all purposes, but failing most completely. Whenever a job came in that had to have some other form of tool the latheman would take one of the six tools, go to the forge and shape it the way he wanted it for the job in hand, charging for the time taken in forging it out. The next job would probably want another form of tool, and another of the six would be called into requisition, and forged as wanted, the workman charging for time of forging the new one, the same as before. This had been done many times to the writer's knowledge, and with such examples is it any wonder that a boy gets strange ideas of right and wrong? The many workings may have improved the quality of the steel or it may not, probably the latter, and it may have given the latheman good practice in tool dressing, but as a model to be followed it is not recommended.

The idea of economy in letting a latheman get along with so few tools is something that passes the understanding of most of us. This stopping to forge a tool or alter a shape for every job is intolerable, and should be discouraged as much as possible.

A few pounds of steel is a good investment when put into lathe tools and kept in readiness for the job that is liable to come in at any time.

OPERATING WOODWORKING MACHINERY.

A man who is unaccustomed to handling woodworking machinery seldom gets cut when he attempts first to dress out lumber (says James F. Hobart in the *Industrial American*). He is afraid of the revolving saws and cutters, and he keeps fingers and thumbs as far away from them as possible. But bye-and-bye, when the fear has somewhat worn off, some of the respect is lost, and a closer acquaintance quite frequently results in making a trade with the saw or planer—a finger or two, for a bit of experience.

The writer, after several years passed in operating almost every kind of woodworking machinery, finds himself with a full number of undamaged fingers and thumbs. This escape from mutilation he ascribes to a little incident that occurred the very first day he operated a piece of woodworking machinery. It was a double bench saw, with two saws, one on either end of the arbor. One saw was arranged for ripping, the other saw for cutting off.

While carefully pushing the boards over the rip saw and watching his fingers "with fear and trembling" lest they get cut, another workman approached and began to saw off the end of a short piece of board upon the other saw.

"What are you doing there, Bill?" asked a man at a bench near by.

"Giving this greenhorn a lesson in running a saw," was the laughing reply. As he spoke he turned his head to give his neighbor a wink expressive to the humor of the occasion, and, at the same time, kept pressing the end of the board against the saw. This man had forgotton, or through familiarity with the work, had neglected to think where his fingers were, and while his head was turned away in the very act of giving that expressive wink, he pushed his hand against the saw and lost part of two fingers and the thumb on his right hand!

That was what saved the writer's fingers. After the excitement of the accident, and the getting of the injured man into a surgeon's care, the writer went back to his work with more respect than ever for that little smooth-looking disc of steel. He decided, then and there, that when operating dangerous machinery his whole and undivided attention should be given to the work in hand, and not a motion should be made, or a word spoken by him, that was not necessary for the safe and economical doing of his work. That decision has been adhered to, and it has enabled him to do more and better work, to keep the machinery in good order, and escape all accidents to the machinery, to others and to his own digits.

To begin with: The saw is always kept sharp, filed to fit the work to be done, and set just enough to work well in the kind of wood that is to be operated upon. These points must be learned by experience or by the teaching of some one skilled in the business; they cannot be taught on paper.

Keep the bearings of the saw arbor well oiled, and see that they never get loose. Saw arbor bearings must always fit snug, but never be tight enough to make the bearings heat. If the arbor is fitted with split boxes, some liners of cardboard or thick paper should be needed between box and cap when bearing is newly babbitted, to allow the cap bolts to be screwed tight without causing the box to pinch the arbor. As the bearings wear, some of the liners should be taken out, and the boxes may again be screwed down tight.

Never allow a saw to be used with spots of pitch, dirt or grease. Such spots will cause the saw to heat, a blue spot will appear on one side, and a permanent bunch in the metal will be the result, and the saw will not answer for any more nice work. Take care that no dust or dirt sticks on the sides of the teeth. In sawing some kinds of wood it is necessary to stop occasionally and scrape off this deposit with a knife or an old file. When cutting lumber that causes the saw to "gum," some kereosene oil squirted on occasionally will almost always make the gum fall off, or soften it so that the action of sawing will scrape it off.

The saw bench should be placed (and kept there) perfectly in level with the saw arbor, and the guide or "fence" must always be perfectly "square" with the saw. The fence should be wholly on the side of the saw next to the operator. Sometimes a fence is made which projects wholly or part way toward the back edge of the saw. This should never be permitted, and such a fence should at once be moved back, or cut off. With the fence in this position it is impossible to split up narrow strips without their catching between the saw and fence and being thrown backwards, with great force, like arrows, across the mill.

For some work, such as rebating and grooving, it is necessary to have the fence project past the saw. Such a fence should never be used for ripping, but if much of both kinds of work must be done, and it is policy to retain the long fence, a strip of wood two inches thick, and wide enough (about four inches) to reach from saw table to top of fence, should be fastened to face of fence by a couple of bolts and thumb nuts, the former flush with face of strip, and the latter tightened up back of the fence. The further end of this strip of wood should come just even with front edge of saw. This rig can be put in place in a minute, and as quickly removed when the whole surface of fence is needed.

Never use a saw when the lumber that is being cut has a tendency to either crawl away from the fence, or bind between the object and the saw. Such a proceeding indicates that the saw and fence are out of line with each other, or the saw is dull and needs setting. Sometimes, when an old "shackly" saw table is being used, a blow on the end of the fence with a hammer or with a block of wood will cure this trouble. In such cases stop at once and repair the machine. To work with tools in that condition is never profitable to the owner or safe for the operator.

Never, under any consideration whatever, put the hand or fingers anywhere around the saw where they can possibly slip against the teeth, or be thrown or drawn there by the sudden catching of any piece of lumber. This means that in splitting up a board into strips 1½" or 2" wide, the thumb of one hand should never be used to push the strips away from the saw after they are cut off, the other hand being used to guide and push the board which is being split up. A "push-stick" should always be used for the above purpose.

"Push-sticks" should always be provided with every circular saw bench, and, in large shops, it pays to saw off a half-barrel or so, and keep them handy. Then the sawyer need not spend 10 or 15 minutes once in a while in rigging up push-sticks. These handy little things are made of board from ½" to 2" thick, and from 10" to 24" long, according as they are to be used for fine or rough work. They are best cut out on the band or jig saw to about the shape of an old-fashioned horse-pistol. A V-shaped notch is then cut in the small end of the stick, so that it may take a good hold of, and not slip off the work.

With a stick of this kind held in the hand that must be placed near the saw (usually the right hand), there is no danger of getting cut either when pushing the last of a board past the saw, or when pushing away the strips that have been cut off.

There is one vital maxim the sawyer must learn—and remember as long as he is in the business. It is this: NEVER *put the hand beyond the saw.* No matter how pressing the demand may seem to be, DON'T DO IT. If a strip of board is likely to fly across the shop and break a window unless caught, get out of the way and let it fly. If possible, take up a long stick and poke the strip away, but *don't* take the hand for this purpose; it is *dangerous* to do so.

A Powerful Ferryboat.

A most unique combination of mechanical and nautical skill in its way, is the passenger car transfer ferryboat which for some time past has been operated in the Straits of Mackinac by the Duluth, South Shore & Atlantic Railroad. As described, it has an enormous capacity for carrying cars, but its peculiarities are its strength, its shape, and the number of its steam engines. It carries 24 steam engines for performing the various requirements of the business in hand. The hull of the boat is a triumph for solidity, and the bow rises up and away from the water, so as to hang or slant over it as if it were a hammer—what, indeed, it is designed to be; this is because the boat is an ice breaker, intended to keep a channel open in the straits all Winter, or to make one whenever it is necessary to encounter the massive ice that forms in that cold region, the big boat advancing toward the ice, and, shoving its nose upon the edge, lifting herself upon it. Then a screw propeller under the overhanging bow performs the work of sucking the water from under the ice to enable the boat's weight to crush it down the more easily. Thus the monster makes its way steadily through the worst ice of the semi-polar Winters of that region, climbing upon the ice, crushing it down, and scattering it on either side.

AN electrical workman of Berlin, says the *Electrical World*, was recently poisoned in a very peculiar manner, which it will be well for electricians to note. In testing his cells, to see if current was flowing, he was in the habit of putting the two ends in his mouth, and the soluble salts of copper produced eventually caused his death. The galvanometer is now substituted in that workshop for this rough-and-ready test, which evidently is more dangerous than most persons would believe.

SPECIAL NOTICE to Readers:

The Premium Offer in the March 1st issue is open to regular subscribers and their friends until further notice.

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Formerly. WESTERN MACHINIST.

DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES.
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Subscription Price in United States and Canada, in advance.................................. $1.50 per year
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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain or brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, MAY 1, 1892.

☞**The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.**

CONCERNING MECHANICAL PURSUITS.

Young man, if uncertain what to adopt for a life's calling, be a mechanic, unless you are sure you are not adapted to a mechanical pursuit. If you are willing to work (and unless you are you can never make anything of yourself in any line), and have no particular talent for any certain business or occupation, you can learn mechanics as easily as anything else. You will have to begin at the bottom of the ladder, and it will seem a hard, long hill to climb. But the knowledge is useful, and will be a permanent capital and endowment to you all your life. It is not best to wait, thinking that something better will turn up. This "turning up" business is very delusive, but catches a good many. Louk out for it. The lottery is no more a game of chance. Ninety-nine out of one hundred have to turn up all their advantages with their own energy and strength. So you had better begin sooner than latter. If an opportunity for a more learned or polished occupation comes along, you can take it and be none the worse off for having gone to work.

And do not look with too much longing on the more polished, "genteel" job and with contempt on the overalls, the grease and labor accompanying shop duties. It is very natural for boys to think it so much easier, smarter and desirable to stand behind a counter or before a desk, with a white shirt and collar and nice clothes on, all day, than to toil in the factory or shop in rough attire and bared arms. But let those who have observed the beginning and the end of many who have entered these careers assure you that the course that looks the least desirable at the outset turns out the better. When you have grown up, married, and acquired a family, you can not correct mistakes. You then have to endure the evil results of bad judgment when a boy. Take our word for it, you will find the chances in mechanics better for a happy, contented life than in a clerkship or profession, unless you have first class advantages for pursuing the latter, and not a little capacity for the one selected.

The mechanic is respected more than he is apt to think. He has more and better opportunities for attaining independence than many of the old soreheads will acknowledge. Do not be guided by the cankered malcontents, who were always out of sorts with society and never amounted to anything. There is no class of men in greater demand to-day than *good*, sober mechanics.

ANOTHER valuable book for busy mechanics and manufacturers wanting practical information is, "An Encyclopedia of Useful Technical Knowledge," (500 closely printed pages and 85 engravings, for $2 in elegant binding), is now offered to the public by the great book house of Henry Carey Baird & Co., 810 Walnut street, Philadelphia, Pa. Read the detailed notice of it in the advertisement elsewhere in this issue.

THE improvement in the manufacture of small arms has been so great in recent years that is is said that a bullet fired from a Maannlicher rifle will go through four men standing close behind each other.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor p easure to assist, through this column, allreaders, if possible, and he cordially solicits practical queries.]

(361.) H. A. H., Laredo, Tex., writes: "Please inform me as to the value of a book published by the firm of Henry Carey Baird & Co., 810 Walnut Street, Philadelphia, Pa., styled Mechanical Drawing Self-Taught. Joshua Rose is the author of the book. Is there a book teaching architectural drawing? If so where can I get it? Is there a treatise on oil refining, and where can I get the same?" *A.*—If you wish our opinion of the merit of the book referred to, we think there is no better work of the kind in print. Baird & Co. willingly give information concerning prices, and will also post you in regard to any other books if you write to them.

(362.) F. P., Macon, Mo., writes: "Please let me know by mail or in your next issue, what is the best formula for black japanning or baked japanning. If you can't, mention me the most modern bock on this subject. I shall be much obliged to you." *A.*—Japanning consists of simply thinning down the japan to the desired consistency, dipping piece to be japanned and hanging them in an oven with a temperature of 180° for from 24 to 48 hours until hard.

(563.) C. McDaniels & Co., Grant, N. M., write: "Kindly answer through your Questions and Answers column, the following question: There are two tanks, one one foot in diameter at the bottom, six feet in diameter at the top and six feet high. The other one foot in diameter at bottom, ten feet in diameter at the top, and six feet high. What is the difference in the pressure of these two tanks at the bottom?" *A.*—The pressure is the same at the bottom of both tanks.

(364.) E. J., Atlantic, Iowa, writes: "Will you please answer the folling in your next issue! We have two 80 H. P. boilers connected together with a 4" steam pipe. Both boilers have the same sized pipe tapped into the dome. After the pipe leaves the second boiler it is increased in size to 6", and the engines are about 12 feet from the boiler. Now, what we want to know is, does the boiler next to the engines furnish more steam than the second one, all things being equal, viz.: That both boilers are carrying the same pressure of steam. If you will answer this in your next you will confer a favor on a constant reader of your valuable paper." *A.*—The pressure and all other things being equal there is no difference.

(365.) J. R., Carpelton, P. Q., asks: "Can you or any of the readers of your valuable paper inform me how to take copper out of nitric acid so I can use the copper after, with other liquids?" *A.*—Wash out the acid by allowing the copper to settle. Then pour off the clear acid and fill with water. Repeat this operation several times. When acid is all washed out, evaporate water by sad bath and the copper remains.

(366.) C. B. R., Buckeye State, asks: "Our shop has a rule to fine every man when he comes late, and to make it more severe at each repetition. There has been a good deal of kicking against it, and now it is proposed by some to unite and force the superintendent to modify it so as not to be objectionable. This is a town where there are few shops, and it is thought by those who are urging the movement that we can soon bring the proprietors to terms because there are no more men to be procured. I want to ask your advise. Would you recommend me to join them, or to stay out? I have never had any trouble with the proprietors or superintendent myself, neither have a good many of the men here, but quite a number have, and they say it may be our turn next. I would respectfully ask your advice." *A.*—It would not be a proper thing to advise you without having a personal knowledge of the circumstances. There are some very mean employers and superintendents, and some very mean men, too. Only a very aggrevated state of affairs, could, in our judgment, justify the course some of your mates wish to pursue. It is always better to settle differences by peaceable means, and generally this method will work it out much more satisfactorily, even in casses where it seems to be of no avail. From what you say we judge that there are a number of men, as in nearly every shop, who come late habitually. If this is true, do not let them get you into trouble. If you are getting along amicably with your employers, personally, let the quarrels of others alone, under ordinary circumstances. We are reminded by this query of a story told a short time ago about a certain mechanic who was a chronic late-comer and grumbler at discipline. When, on account of slack orders, the works began at 8 o'clock instead of 7 o'clock, it was remarked that Jake could now get down to work on time, this being one bit of the supposed good which this evil wind of destiny would blow. But when the machinery started up at 8 o'clock Jake was not on hand. About a quarter past, he was seen climbing over the fence, in order to get in "by some other way" than through the office. He had a little pride left, which is more than can be said of some constitutional kickers. We shall always take the part of men against tyranny, but peaceable men should look out for the class of chaps not content to be in hot water themselves, but are continually itching to drag others in with them.

A RECENT invention consists of a combination of levers in connection with the trucks of a railroad car, so that in case of derailment the air brakes will work automatically and stop the train.

ANOTHER substitute for gutta-percha has been discovered, which is insolubie in water, and hardens and softens with cold and heat.

PATTERNS FOR LIGHT CASTINGS.

BY J. LEON GOBEILLÉ.

Almost any good wood-worker can make an ordinary machine pattern f given time enough. The large pattern shops do not have so much diffi- ulty in getting men who can make good patterns, as in inventing methods or making them quickly.

This is not true, however, of very light work, which is put through in n entirely different manner from ordinary patterns. No trade journal has een able to get trustworthy articles about light or ornamental patterns, ecause it is obviously against the interests of the shops making a specialty f this sort of work to say anything about their methods. It is the purpose f this article to explain the work so as to be understood by every reader vho is a wood-worker.

Suppose we take the oven door of a cooking stove as a familiar exam- le. Fig. 1 shows the outline, which must have been accurately laid out vith shrinkange added.

Fig. 2, is a vertical section, showing moulding.

First you will make your form or "followboard." This will be in two ections, horizontally, made to correspond with the inner lines of Fig. 2. 'he first you will get out like Fig. 3.

Now get out the top like Fig. 4.

Fasten the two pieces together with a few spots of glue: be careful to ee that the margin is equal all around. Next turn up a circle for your orners, see Fig. 6 with followboard, saw it into four pieces, glue the ollowboard pieces into the places left for them and give the whole thing coat of shellac varnish, sand paper it, and rub over a little grease or tal- ow, so the pattern will not stick, and your followboard is done. Now you re ready to "cover" the pattern.

The edge is $\frac{3}{16}$″ thick and the body $\frac{1}{14}$″. It is a nice operation to lane up thin stuff. First take one side "out of wind," then gauge your hickness and go carefully to gauge mark. It is best to get out this stock n pieces of about 30″ long and not more than 6″ wide. In covering put n your corners first, then fit in the $\frac{3}{16}$″ pieces, which is straight work ex- cepting at A., bend this around in two thicknesses, glueing them together, fter fitting on a "bender," fastening all pieces by means of slender tacks riven through into the followboard. This "bender" is indispensable. . simple form is like Fig. 5, which is a fragment of stove pipe fastened to piece of inch board. A spirit lamp is placed inside. The wood being ressed at right angles across the hot metal until the desired curve is btained, trim off the top of *a* and glue *b* which is $\frac{1}{14}$″ stock, then bend *c* cross the direction of the grain except at *a*, which must be made of small iangular pieces like Fig. 7, well glued together.

~ Fig. 1 ~

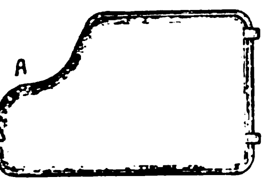
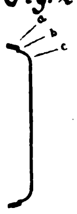
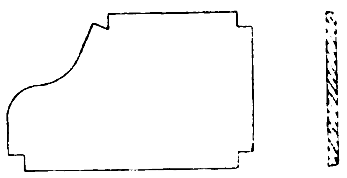


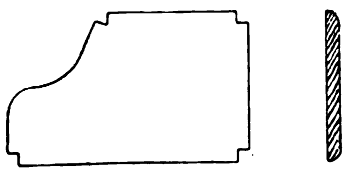
Fig. 2



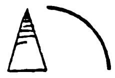
~ Fig. 3 ~



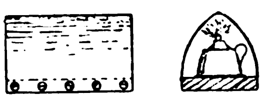
~ Fig. 4 ~



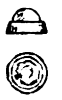
~ Fig. 7 ~



~ Fig. 5 ~



~ Fig. 6 ~



Your pattern being all covered, pull out the tacks, take the shell from ie board and clean off the glue from the inside, then put the pattern back id clean up the outside using No. 0 sandpaper to smooth the surface. he hinges and catch are small matters, and when done you will have iade a pattern to be proud of in much less time and of more even thick- ess (of great importance to the moulder in this class of work) than if you id gone at it in the old fashioned way, working mouldings and backing it from the solid wood. When you can get out this oven door in good me and in a workmanlike manner, you have solved the problem of light attern making.

The ornamentation and varnishing must now be done, which may be ken up later.

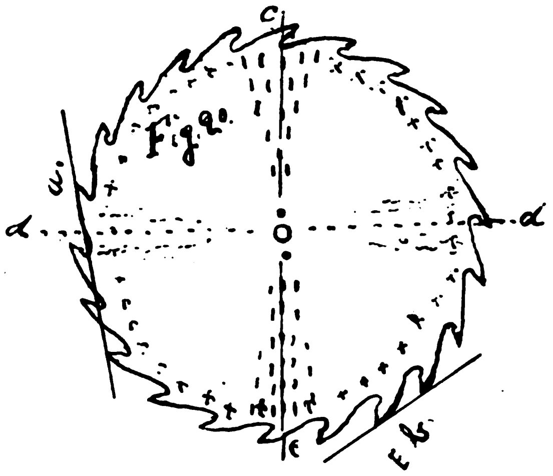
BENCH SAWS.

BY C. E. GRANDY.

"Every man to his trade;" if I should branch out on to something e it would be speculation. I have given saws a life-long study in run- ing, hammering, recutting, filing, etc.

Of all the saw family the bench saw, where the lumber is fed to the w by hand, should be in the best possible condition as to tension, style f teeth and set, and general arrangement, for when I say that 75 per cent. f them take double the muscle that should be necessary to feed the work p to the saw, it follows that there is room for considerable preaching. gain, new men are being constantly put on this saw, for it is regarded as mewhat automatic, and so simple that any greenhorn can run it. This so, after a fashion, and if a body could see the bench saws brought in r me to repair they would say that a "greenhorn" of the greenest hue d been at them. They are blistered and twisted all out of truth, with teeth so obtuse or "stout" that they take double the power and cannot possibly do work well. In a majority of cases the teeth of bench saws are filed so as to leave the back of the teeth too high, much too high (see *a*, Fig. 20). As a rule the back should be low enough to clear a straight line from the point to the third tooth back (see F. *b*, Fig. 20). The reason for this is that in moving the work forward on to the saw there should be a large amount of clearance. With high backs it is similar to pushing against a circular disk without teeth. Such a proceding of course heats the rim and it grows large and is held to diameter by the cool center. As it has to go somewhere it kinks out in reverse curves. The cutting line in the board is like it, and shows the reverse curves. This is exactly what takes place, and it is exactly what is not wanted. Besides, it is much harder work for the operator. The object of a sawyer is to get the most work from his saw and in the best manner. I once heard a sawyer say that he had lost a year's wear of a saw because the teeth had been cut over at the shop and were nearly straight from point to root on the back. But when he put the saw on and had run it, he came to the conclusion that he would saw enough more in the next year to more than make it up. Bench-saw teeth should not be too long. For hard wood they should not be over three-quarters to seven-eighths of an inch long from point to bottom of tooth. Some saws are sent to me to re-cut with three or four teeth broken out. Those not broken out show the cause at once. There is not stock enough at base, or they have been given an abominable amount of set. This causes the teeth to draw sidewise or "make set." This cracks them at the root and they are soon out. Saw makers say a great deal about keeping round gullets, but as long as files are furnished with a square corner sawyers will be very apt to leave square corners in the bottom of saw teeth. I think it is well to have round corners or gullets, but the teeth, if properly filed and set, and of the right shape, should not break even if the gullets are square.

It is well to have a guard behind the saw, but it should in no wise act as a spreader; it should be thinner than the set and exactly in line with the saw. Its duty is two-fold; to act as a guard to keep the lumber from catching on to the saw, and in a measure, to act as a guide when small saws are used. The fence, or side-guide, for dimension sawing, should be as long as the diameter of the saw, and extend only to the center of the saw. The rest of the length of the fence should be in front of the saw, to act as a guide in giving the lumber the right direction before the saw begins to cut. That part of the fence at the center of the saw should be a trifle farther away from the saw than at the edge. Only a little, however, otherwise it would give a wrong direction to the cut. I have often seen men pushing against a saw with the fence set so as to be continually forming a wedge. This could not go on long, for the saw would soon become hot, and if persisted it would become blistered. The saw grows too large at half the distance from center to edge. Generally one or two, sometimes four places buckle out and heat to a black or blue color. The plate sets, and when cool stays bulged or "blistered." Everything is at sea now. There is no remedy for this but to hammer these spots back, that is, bend them back. The best way is to use an anvil and "good dog" head hammer. Put a piece of sheet copper between the hammer and saw and strike very hard blows, enough to set it back. The tension of the saw is destroyed then. Just where and how much I cannot tell, except by trueing up the saw as much as possible and then testing, as described in Figs. 4 and 5, "Some Facts about Saws." Generally, however, the center is too large, and the saw should be hammered in places clear around the saw on both sides as indicated in Fig. 20, *a*. This can be done on a smooth-faced anvil with a slightly convex hammer for bench-saws; a hammer weighing two lbs. will do. When the hammering is carried far enough at this point to take out the tendency to snap, like the bottom of an oil can, it is enough for a high-speed saw.



Many bench-saws become permanently warped; that is, if tried with straight-edge they would be crowny across the saw as at *c*, *c*, straight line, Fig. 20, and hollow or concave the opposite way, as at *d*, *d*, dotted lines. When this takes place the novice should send his saw to the shop, or if he has an anvil and twist pene hammer he should strike blows along the high place with the long way of the pene, as shown by the marks at the line *c*, *c*, and turning the saw over at *d*, *d*, proceed in the same way. This should be continued until the warp is out and the plate is comparatively level. Then true it up as usual and fix the tension. Now, here is a fine point, viz., the saw may take this form from being too large on the rim. It will then snap back and forth; what was high will be low, and what was low will be high. This is not a warp at all. It is undue tension on the edge. So the party should distinguish between the two conditions, for a saw in this state would only become worse if hammered as described above. —[From Mechanical News, by courtesy of Editor and Author.

Practical Letters.

To De-Magnetize a Watch.

EDITOR SCIENTIFIC MACHINIST:

In reply to "John S.'s" question, issue of April 1st, "How long will it take to demagnetize a watch, and how is it done?" A very simple way is to take a piece of strong thread about four feet long and pass it through the ring of watch case, tie the ends together, to prevent watch from slipping off. Now twist the thread up, and suspend the watch in a strong magnetic field, between the two poles of a dynamo, preferably. As the thread begins to untwist and the watch to revolve quite rapidly, gradually recede from the dynamo while the watch is still revolving, far enough to be out of the magnetic attraction. This may be repeated several times, but after the first time, always have the watch revolving when approaching or receding from dynamo.

J. G. KING.

That Buried Money—Education.

EDITOR SCIENTIFIC MACHINIST:

Your correspondent A. L. S. seems to be anxious to obtain money that was buried many years ago, and wants some instrument to help him find it. Now, it is no doubt as much his as any one's, but is it hardly a commendable spirit, that endeavors to obtain money without having earned it? Probably any of us would dig for it in order to get it, but when we really think what money is, only an equivalent for labor performed, and to think that this money represents the labor of some one long since gone, would it not be a healthier effort of our minds to try and *earn* what we receive. Don't be offended, A. L. S. We are all in the same boat, perhaps, but it seems to me that the desire to obtain money without giving a fair equivalent, should be discouraged.

I thoroughly agree with V. L. Stockton in his remarks on the learning question, and I am with him in the "minority." There is no question in my mind but that the future of the working man lies in his education, not only in shop matters but in social matters as well, until he thinks and acts according to his knowledge. When he acts as his own thoughts dictate he will no longer be lead around to do as those who endeavor to keep them in subjugation wish him to. However it must not be thought that I am advocating revolution, in its stead. I fully believe in "evolution," and it seems folly to attempt to use force in anything, except as a matter of defense. When the social question is more thoroughly studied and the underlying fact becomes well known, that the earnings belong to those who create them, the want and poverty that besets us will be materially lessened. I should like to hear from Mr. Stockton on this phase of education as well as the other, and think that a little controversy may do us all good, am sure the editor will allow us the space for it. Algebra is a very useful branch of arithmetic, and its application in the formulas of every-day life are certainly proof enough of its great saving of time and labor in the solution of many problems. The question is, how can we best present the subject to interest and at the same time instruct the readers? When we can do this successfully we are on the road to an ideal paper.

FRANK LYNN.

Criticism, Answers and Suggestions.

EDITOR SCIENTIFIC MACHINIST:

I am an interested reader of your valuable paper. The "Questions and Answers," "Practical Letters" and special articles are very helpful to me. Now, Mr. Editor, I do not want to find fault. It is easy to pick flaws, even with the most meritorious articles and things, and there is no individual more detestable than the chronic whiner and fault finder. So, in speaking of the matter I shall mention, please understand that it is in the most friendly way, and more as a suggestion than a criticism. I notice that there are some very excellent writers for your paper who do not confine themselves to practical matter and shop work, but use more space than seems to me proportionate in the discussion of things pertaining to conduct and morals. Not that the letter is of minor importance, but that lectures have to be short and to the point, and be brought in where the reader is interested, to be effective. I do not think it a good plan to start out an article like a sunday school superintendent starts his talk. I think if the lessons to be taught are brought in where they will not be looked for, and ended before the reader gets weary, they will do more good. The mechanical paper is first for technical instruction and second for the all around healthy development of the man. And this is not a sling at the sunday school, either. The more of them the better, and the more good writing on morals the better, but let discretion be excercised in spreading on.

I am afraid that the correspondent who writes for information on perpetual motion patents is dangerously near the line that separates cranks from the majority of people.

The party who inquires whether there is a patent on the eccentric will be able to find an answer to his inquiry in the articles of Prof. Thurston in the SCIENTIFIC MACHINIST on "The Development of the Steam Engine." If I remember rightly, the ingenuity of a boy led to the adoption of the eccentric. One of the pumping engines used prior to Watt—whether Hornblower's, Savery's, or some other person's I do not know—was fixed by the boy who was stationed beside it to cut off the steam by hand, so as to perform that duty itself. I think he fastened one end of a string to the crank and the other to the valve, in order that the revolutions of the crank could cut off the steam temporarily while he went away—whether to play or to do some duty I do not remember. But, it will be seen from this that the eccentric can not be patented. The idea was at once adopted and a rod substituted for the string, other improvements following.

I am interested in the next interview between "The Old Man" and his engineer. I wonder how well that engineer will prove to his venerabl nibs that it would pay to buy a new engine. I hope he will succeed, fo I am an engineer myself and am glad to find intelligent men in the craft I wish the mechanical mogul above alluded to, or some other person would tell me how to set the valves on an Armington & Sims engine. would like to express the hope that Mr. James F. Hobart will not, as s many writers on engineering do, make his interesting articles, (for I suppos there are to be more,) too high up for the greasy engineer, who has nc gone through Cornell University, to understand. Still, the editor know best what strikes the majority. I have liked the paper more on account c the plainness of the language, in answering questions and in the article throughout, than anything else.

Mr. Woodward's "Hints to Engineers" have been very instructiv and valuable. I judge from his articles that he has had experience wit agricultural and other engines brought in for repairs, having been "eng neered" into beautiful shape by our "country cousins." I am expecting t go into a shop where such work will have to be done, and if Mr. Woo ward will (if he can and if he pleases) give us some useful hints on puttin these engines in shape, I for one will be obliged.

I will close this long (and perhaps too personal) letter with a request t engineers, to write up their experiences and ideas, as some have in th April 15th issue, and another to the editor to light his pipe with this if h thinks it worthy of no other office.

J. J. H., Akron, O.

Another Reply to "John S."

EDITOR SCIENTIFIC MACHINIST:

The following, from the *Electrical Review*, is sent us by the *Railw* *Review*, in reply to "John S." in a recent issue. "A simple method, y one that is said to be quite effectual for demagnetizing watches, has bee devised by Mr. P. D. Richards, of West Medford, Mass. A compoun horseshoe magnet is placed conveniently with the poles up, and over suitable support a thread is carried, having attached at one end a cardboar scale pan holding the watch. The thread is allowed to untwist itself as th watch is slowly removed from the magnetic field. An electro-magne would answer the purpose as well, but the permanent horseshoe magnet within reach of every one."

FLYING-MACHINES.

There is nothing to prevent man from flying, like the eagle of th Alps or the condor of the Andes, except his want of inventive skill; an if the signs be true, this will not very much longer prevent the desire consummation. Nature has not given man wings; neither has she give him fins, yet he outstrips the strongest of the finny tribes in traversing th deep; she has not given him weapons, yet he vanquishes the fiercest wa riors of the forest and jungle; she does not protect him from cold or hea yet he is neighbor both to the polar bear and the tropical elephant.

There is no miracle in the swallow's arrowy flight; it only applies th well-known laws of dynamics. Darius Green's logic was good so far as went. * * * *

Man may equal and even surpass the swallow in speed, but he ca never possess the swallow's perfect command of his movements in the ai to curvet and turn at sharp angles like a ray of light from opposin mirrors. * * * *

Man will never poise himself in the air like the dragon-fly, nor zigz through it like the swallow. Nevertheless, there appears to be no adequa reason why he should not, some fine Fourth of July, astonish

"the nation
An' all creation
By flyin' over the celebration,"

if he can only devise a motor, with the necessary accessories, which will n add too much to his own weight. But even great additional weight w not be an insurmountable obstacle, provided a sufficiently rapid moti can be attained.

It takes time for the geeatest power to move the smallest mass; t is to say, if a force were applied for only an instant (*i. e.*, a point of ti to a mass, it would not move it in that instant. If, then, a great wei should press for only an instant against a small resistance—as that of air—it would for that instant be sustained. Hence it is only necessary the weight to move fast enough horizontally to rest for only an instant u any given mass of air, in order to be sustained. As it moved from m to mass it would not have time to fall through any one of them. course this condition can be reached only approximately; but the clo the approximation, the less uplifting power would be required in motor.

The principle is strikingly illustrated by Mr. Langley, of the Sm sonian Institution, by comparing such a mass to a skater moving rap over thin ice. The briefest pause or diminution in his speed, and his s port would instantly yield; but it is only necessary for him to move enough to glide over a film as thin as tissue paper.

Here, then, is the problem of aerial navigation theoretically sol Given a mass of any size or weight, spread laterally so as to rest upo sufficiently large mass of air, and moving with sufficient speed horizonta and your flying-machine, so long dreamed of and so ardently sought achieved!

Such is, or is to be, Professor Langley's *Aeroplane*, the realizatio the magic carpet of the "Arabian Nights." May fortune and his ha genius bring speedy success!—[Julien St. Botolophe, in North Ameri Review.

A LIFEBOAT of aluminum has recently been built at Stralsund. It be a matter of considerable interest to see how this boat will answer, w thoroughly tested, for it seems more than likely that its obvious g points will be counterbalanced by various disadvantages.

MELTING IRON.

Under the initials of H. R. H., an engineer connected with a large works is contributing to *The Metal Worker* a series of articles on stove manufacture, from which we take the following relating to foundry practice:

In no other department of a stove foundry are the results so often questioned as those obtained in melting iron. Charging lists showing high ratios of iron to coal are viewed with suspicion until the coal and iron accounts have been examined and found correct. All foundrymen take pride in exhibiting melting statistics which show a high ratio of iron to fuel. These are of little value unless accompanied with more complete data as to the loss of plate due to bad iron, the dimensions of the cupola, amount of iron melted and the time taken to run off the heat. A high ratio of iron to coal does not necessarily indicate economical melting. It undoubtedly shows a saving in fuel, but this can be easily offset by other losses which make this saving a positive disadvantage. In the various designs of cupolas met with in the stove industry the principal points claimed are greater economy in fuel and less time required to melt a given quantity of iron. These claims are made with the understanding that the quality of iron produced shall be the same and that the repairs to cupola lining shall be no greater than in any other form with which comparison is made.

There is great room for lessening the amount of fuel required to melt a given quantity of iron. Under the best conditions the ordinary cupolas has a very low efficiency. Hardly one-third of the total heat of the fuel is utilized in melting the iron. Many attempts have been made to secure greater efficiency, with but partial success, so that to-day a greater or less ratio of iron to coal depends almost entirely upon the amount of iron melted. Aside from the great amount of heat carried away by the blast, the bed of fuel is the great obstacle to overcome. Where this is distributed over a great quantity of iron the loss becomes less. Hence the cupola meling the greater quantity of iron will necessarily show the higher ratio of iron to fuel. Another barrier to progress in fuel saving is the prejudice of the ordinary melter. His experience tells him that just so much fuel is necessary for a given quantity of iron. Convince him to the contrary by using less for a given period and the slightest variation in the conditions under which proof was made will be sufficient cause for him to use his own judgment and fall back to his own ideas of the amount required. Probably the cost of unsuccessful experiments with a cupola deters most foundrymen from investigating the question of fuel more thoroughly. They must be made under the conditions which occur in daily practice to be of value. If bad iron should result, no matter to how great a number of other causes it can justly be attributed, it is laid to the diminished quantity of fuel used and is sufficient reason for the melter to quietly increase this quantity. Knowing these facts, it is no wonder that the fuel accounts need careful watching. More perfect combustion is the essential factor in reducing the amount of fuel required. To effect this some inventors have introduced rows of tuyeres to admit air at different points so as to consume the carbonic oxide. Theoretically cupolas of this design should show greater efficiency. Innumerable forms of cupolas exist. Every foundryman has his own ideas and consequently nearly all cupolas vary in some particular. The outline is varied in some respects; the tuyeres are of various shapes and sizes; the blast pipes and wind belt connected and proportioned differently. Of the innumerable forms in use, undoubtedly the most popular is the straight cylindrical stack. As good results—considering ratio of iron to coal, quality of iron and repairs—have been obtained with the plain stack as with any of its many modifications, and for true economy it is not surpassed by any.

Probably the sizes of cupola most used in stove plate foundries are those having an outside diameter varying from 5 to 6 feet. These can be used to economically melt any quality from 14 to 20 tons, and in case the cupola is slagged out the amount which can be conveniently melted may be put at between 30 and 35 tons.

The following general specifications may be of service to those contemplating erecting a cupola.

Hight to be from 45 to 60 feet, depending on existing conditions.

Cupola to be constructed from good iron, and the various sections to be securely riveted together and to each other. The two lower sheets to be ⅜" thick; ¼" iron to be used from this point till the charging door is passed and 3-16" iron used in remainder of the stack; strengthening flanges to be placed at top and bottom of cupola. The bottom one to be 3½"x1" and the top 2"x1", securely fastened to shell.

Two rings of angle iron to be securely riveted to the shell, one midway between bottom and charging door, and other just above charging door, to permit of repairs being made to any section of the lining without necessitating the removal of the whole.

One or two openings, depending upon the amount of iron to be melted, to be left about 12 to 15 feet from the bottom for the purpose of charging. These openings should be 3' 6" across by 2' 6" or 3' high, and provided with a frame securely fastened to the shell on which the charging doors may swing. In case no charging doors are used the metal of the shell may be turned into a strengthening flange and the frame discarded. In case charging doors are used they should be framed so as to hold a brick lining for their protection.

Suitable openings, varying in size and form, should be left in the bottom sheet for the admission of the blast from the fan or blower. The total area of openings should be from 10 to 15 per cent. of cross section of cupola. Tuyeres of proper form and size should be made to fit openings in shell and conduct blast through cupola lining.

A wind box of proper size should be riveted to the cupola at a given hight to conduct the blast to the different tuyeres. The wind belt should be made air tight to prevent loss.

A very heavy bottom plate on which cupola rests should be furnished, provided with suitable legs for swinging the bottom doors.

The frame of the bottom doors should be of heavy iron and covered with a light boiler iron—say ⅛" or 3-16" thick.

Iron columns or brick foundation should be provided which will hold cupola securely a proper hight above bottom of pit to allow the bottom doors to swing freely and the dump to be easily removed.

A proper scaffold of suitable dimensions should be erected. Its size depends entirely upon the amount of iron melted and the stock which it is desirable to carry at this point. Many foundrymen keep the stock on the scaffold very low, while others keep at least one day's supply ahead to provide against possible accident.

Having the cupola in position, scaffold erected and the air pipes connected, the cupola is ready for its lining. The brick used are from 5" to 7" long, 2½" to 4" thick and 6" to 12" wide. These are laid in a thin grout of kaolin and fine sand and they should be properly keyed to prevent jarring out of place. The grout for laying the brick is made from equal portions of fine clay and fine sand to which a quantity of rock salt is added. These are mixed in water, boiled and strained and the grout is then ready for use. Split brick are found necessary in filling in around tuyeres, charging door, and in completing the different courses. Where the area of cupola is contracted above the tuyeres, a special lining is necessary for a certain distance and then the uniform size of the brick can be used. In some foundries a thinner lining is used above the charging door, as the heat there is much less intense. The greatest repairs to the cupola lining will be found necessary at the melting point, where the greatest heat is and where the greatest wear is from chipping down. It will be found necessary to reline the first sheet about two or three times a year and to extend the repairs as far as the charging door once in the same period. Above the charging door the lining will be found to last a number of years. A slow fire should be used to dry out the lining, in case the cupola is to be put in operation before the lining has a sufficient time to become seasoned

The first work of preparing a cupola for melting is to put in the sand bottom. The bottom doors of the cupola are braced in position and old molding (or sand obtained from cleaning the gangways after shop is in operation) is used to cover them. The sand bottom should be about 5" to 7" thick at the tapping hole, and slope gradually to the rear and sides, thus causing the iron as melted to naturally run toward the tapping hole, and permit the cupola to be cleanly tapped.

The runner or spout from cupola, over which the iron runs to the ladle, should next be covered with a mixture of fire-clay and fine sand, and grooved so as to have the iron flow in a proper stream. The breast is next placed in position. This may either be a fire brick with a hole of suitable size for the iron to flow through or a mixture of fire clay and fine sand packed in the opening of the cupola shell. In case the cupola is in operation, the first step necessary is to chip down. This consists in removing the portion of fuel, iron and slag which adheres to the cupola lining or which may be left in the cupola when dumped. Care should be taken in this work that the lining of the cupola is not badly broken, and that the necessary daubing and patching are done properly, so as not to leave high projections on which the charges may be liable to catch. After having chipped down the cupola the process of preparing a cupola, thus far described, is repeated.

The kindling is next placed in position. Shavings are laid around the edge of the cupola so they can be lighted from the tuyere openings. Small pieces of wood are then placed over these but free from them to allow proper draft. Cord wood, slabs or other wood is then put crossways of cupola, being raised in the center to permit of a good draft. The bed of coal or coke is now put in cupola and it is then ready to light. The cupola is lighted about 2 or 2½ hours before the blast is put on, and the iron is charged after the bed has become sufficiently ignited. Generally the charging commences in about three-quarters to one hour after the bed has been lighted.

Having charged the desired amount of fuel and iron, or all that it is possible, as the case may be, and the time for putting on the blast having arrived, the outside openings admitting air to the tuyeres should be tightly closed and the signal given to start the blast-generating machinery. The valve admitting the blast to the cupola should be but slightly opened until the iron shows in proper form at the tapping hole, which will occur in about ten minutes after the blast has been on. The tapping hole should then be stopped, the valve for the admission of air opened wider and the pouring of the molds proceeded with. The first few ladles of iron should be put in the cheaper class of inside plates, such as grates, fire-plates, etc. By this means all the iron is used, and the poorest placed in plates where it will do no harm. After all the molds have been poured, the iron should be tapped as cleanly as possible and the cupola bottom dropped. Some foundries use a large form of heavy iron operated by a windlass for breaking up the dump, and making it easy to remove. The large cupola forks, in places where this arrangement is not in use, should be used to break up the dump. While not so effective as the first method, the latter will be found useful in facilitating the removal of the refuse from the previous day's cast.

In many foundries large pieces of scrap plate are thrown in on top of the bed to prevent the iron from sinking unevenly in the fuel or breaking the same too much. The first charge of iron is put in cupola, and then follow successive charges of fuel and iron until the desired amount of iron has been used. The various brands of iron used should be distributed well in charging so as to give a uniform mixture. In many places the pigs are broken in quarters. This permits of easier melting and allows the irons to mix well. In foundries where this practice is not adhered to, the argument advanced is that the saving in fuel is not sufficient to pay for the labor, and grave doubts are expressed as to whether the irons mix any better.

No two cupolas are charged exactly the same. The amount of fuel on the bed or between the charges differ, while varying amounts of iron are used in the charges.

On the following page will be found charging lists from some of the prominent stove foundries in the country:

A—Bed of fuel, coke	1,500 pounds
First charge of iron	5,000 pounds
All other charges of iron	1,000 pounds
First and second charges of coke, each	200 pounds
Four next charges of coke, each	150 pounds
Six next charges of coke, each	120 pounds
Nineteen next charges of coke, each	100 pounds

Thus for a melt of 18 tons there would be 5,120 pounds of coke used, giving a ratio of 7 to 1. Increase the amount of iron melted to 24 tons and a ratio of 8 pounds of iron to 1 of coal is obtained.

B—Bed of fuel, coke	1,600 pounds
First charge of iron	1,800 pounds
First charge of fuel	150 pounds
All other charges of iron, each	1,000 pounds
Second and third charges of fuel	130 pounds
All other charges of fuel, each	100 pounds

For an 18 ton melt 5,060 pounds of coke would be necessary, giving a ratio of 7.1 pounds of iron to 1 pound of coke.

C—Bed of fuel, coke	1,600 pounds
First charge of iron	4,000 pounds
First and second charges of coke	200 pounds
All other charges of iron	2,000 pounds
All other charges of coke	150 pounds

In a melt of 18 tons 4,100 pounds of coke would be used, or a ratio of 8.5 to 1.

D—Bed of fuel, coke	1,800 pounds
First charge of iron	5,600 pounds
All charges of coke, each	200 pounds
All other charges of iron	2,900 pounds

In a melt of 18 tons, 3,900 pounds of fuel would be used, giving a ratio of 9.4 pounds of iron to 1 of coke. Very high, indeed, for stove plate.

E—Bed of fuel, coal	1,900 pounds
First charge of iron	5,000 pounds
First charge of coal	200 pounds
All other charges of iron, each	2,000 pounds
All other charges of coal, each	175 pounds

In a melt of 18 tons 4,700 pounds of coal would be used, giving a ratio of 7.7 pounds of iron to 1 pound of coal.

These are sufficient to demonstrate the varying practices existing among different stove foundries. In all these places the iron was proper for stove plate purposes, and apparently there was little or no difference in the kind of work in the sand at the different foundries.

It will be noticed that the best ratio of iron to coal is obtained where the heaviest first charge of iron is used, thereby utilizing a greater proportion of the heat contained in the bed. Where heavy charges of this kind are used, it is essential that a large number of men draw from the cupola when this charge comes down, preventing the iron becoming dull by standing, or effectually stopping any possibility of the iron running in the tuyeres, in case they are near the bottom. Care should also be exercised that too much iron is not charged on the bed, or it will be found that too much of the bed will be exhausted in melting it and dull iron will follow for a portion of the cast, until the bed has been replenished sufficiently by the successive charges of fuel.

The amount of iron charged before the blast is put on depends on the size of the cast. In the case of a heavy melt the cupola is filled to the charging door and allowed to stand until the iron is tapped and room is thus made for more to be charged. Where the cast does not run so great the practice is to put in one charge less than was used the previous day, and to afterwards charge what is found necessary from "taking up the iron." This is merely a visit to each molder to find the amount of iron, greater or less, he will need to pour the molds he may put up. Balancing this list gives the amount, more or less, by which the previous day's melt has to be changed to obtain the proper quantity for the day in question. The quantity of iron named by the molders is sometimes far from correct—especially on Saturdays and Mondays—and unless the melter keeps a sharp look out during the progress of the cast, there will be an abundance of iron left over. This state of affairs can be provided against only by reducing the amount of iron below that found necessary by a canvass of the shop and then standing ready to add an extra quantity of iron when necessary.

The question of overcharging a cupola has been often discussed. The Western foundries make no attempt to run their cupolas close, and consequently have a very large quantity of iron and fuel in the dump. Such practice insures good iron for the last molds and reduces the wear and tear on the cupola lining. It is of questionable economy, and a comparison of costs with the foundries running their cupolas close will undoubtedly show that the cupola costs per ton of perfect castings are very high. Again, a large amount of fuel is wasted in melting this excess of iron, and while many of these foundries will show very fine results on the basis of iron charged to fuel used, when perfect castings to fuel used is taken as the basis of comparison, the favorable showing is greatly reduced and in many instances wiped out. Really the latter is the true basis of comparison; because, where a foundry uses no outside scrap the perfect castings should be equal to the pig iron used, added to any plate thrown out from the racks from any cause aside from discount and broken, this amount being reduced by the usual percentage of loss in remelting. As every foundry tries to reduce the loss from obsolete plate and incorrect patterns to a minimum, the weight of castings thus discarded has become a very small per cent. of the total product in the best managed foundries, and for the purpose of argument can be omitted.

The problem then presented is: How much fuel has been used in melting a given quantity of pig iron? If in melting 3,000 tons of iron one foundryman's practice compels the charging of 6,000 tons of pig and scrap, while another gets along with 5,000 tons of pig and scrap, the first has actually wasted the fuel necessary to melt 1,000 tons of iron, which we will say is 140 tons of fuel, which, at $5 per ton, amounts to $700—quite an item. The advocate of overcharging may say that this loss is easily made up in better iron and less repairs to cupola. To which may be replied that there are foundries where close charging is the practice which have uniformly good iron and a very low cost for cupola repairs. It is true that there are other causes aside from overcharging, such as the size of sprews and gates, gangway loss, broken and discount, which affect the percentage of perfect castings, yet there is no foundry in which the overcharging idea rules but might effect a very handsome saving by confining the weight of iron charged more closely to the actual wants of the molders.

LECTURES BY THE OLD MAN.

(Continued from a recent issue.)

It does seem hard and cruel, too, when you come to think of it. Here in the past each and every fellow on the pay roll has been dodging 'round like a comet flying through space, bumping into everybody else and keeping everyones' nerves all on a tension so that they have become accustomed to it and think it necessary. And now it must all be changed into a perfect solar system with each planet swinging in its own orbit, regardless of the doings of its neighbor and all going to make up one complete whole. There will be many heart-aches among owners and employes, but it will be music after the work is completed. All discord vanquished and harmony enthroned here, will make it seem like Sunday all the week. Guess I will get real well acquainted with that engineer.

Good day, young man, what were you just grumbling about as I came up behind you? You were getting tired of this old lathe, you say. How long have you been running it? Two years? How long have you been at the trade and how long have you worked here? Two years? Well, I should think it was time for you to get tired. Are you an apprentice or did the firm just hire you as a "lathehand?" You came to learn the trade and have "kicked to the foreman" for a change until you are tired and his only reason is that they can't spare you off of this work? You are a most valuable man to us, don't you see? Now, it is very good in you not to die off very sudden without giving notice, for we would have to stop the works if that foreman's reasons hold good. Well, I think I will see that man about your case myself and have you changed over on to floor work. How would that suit you?

Ah, here he comes now. Speak of angels and we hear the flutter of their overalls. Mr. Foreman, suppose we put this young man over on the other side of the shop on the floor erecting? You think it would be a pretty good idea for him, but bad for the firm as there is no one to take his place and he has got the workings of this machine down fine and it would require some time to break in a new man. Well, you have given a whole bunch of reasons and they seem very logical and good, but I would just as soon have a whole bunch of onion top for dessert at a Delmonico dinner. I want this young man put over there where he can be of more advantage to the firm and where he can be of more advantage to himself in time to come, and if there are any more men or boys around this establishment that can not he spared from work they are doing, just let me know all the particulars and we will promptly make a change.

This idea that the world must stop a day or so because one of us small atoms of humanity takes a notion to drop out of sight is all nonsense. The valuable man of the present generation is one who can fill any position in an emergency, not the man who is only able to do one thing. Some day you and I will drop out and we want to leave things so that some one else will drop right in after us and avoid all sudden shocks and jars. I hate shocks and pounds in business just as bad as I do in machinery. Let's don't have any.

So you are going to fit that new universal chuck to the 24-inch lathe, are you? Well, see that you get a good fit on the spindle screw and not have it too loose. By the way, as that is a new lathe also as well as the chuck you may see if it is perfectly true and is satisfactory after you get the chuck fitted. You don't know how to find out if it is true? Well, it is about time my boy that we did learn. You will find me upstairs in the drawing room when you want me to help on the job.

Good morning, Mr. Draftsman, how are you coming on with that oscillating engine for the electric works? You are waiting for me to bring you the design for you to work from? Why, Imperial Moses, man, you don't want me to come round and do the drawing for you, do you? Perhaps I had better come in and get out a few blue prints occasionally, too, when I am not busy. The other Superintendent always furnished his own plans for you to work to and that has been the custom here, hey? Well, I guess we will change that custom a little right now. You go to work and knock out a few designs of that oscillator, and let me see what you have in your head in the way of originality, anyway. Probably, I want like it, but it is much more probable that I will. The idea of having three great stout (in their heads I mean) draftsmen standing round with cobwebs growing on their brains while I furnish designs for them to work from! but I suppose that was one of the rules of my late lamented predecessor. No wonder he died. Trying to do the work of two or three hundred men of all grades of mental and physical power will kill any man early, and the credit for being a real smart man while alive don't help one after he is dead, either.

I remember not many months ago, a superintendent of a plant telling me that he did all his own designing and that he also did it all at home at night. Five nights a week he shut himself up in his "sanctum sanctorum" secluded from family and friends and "designed." What? Wind mills! He also remarked in a casual sort of way that he "had a young man in the drawing room who had spent some years at Cornell College and Sibley, and he was training him to know something and had great hopes for him in the future." By the beard of Thurston! That was the rankest assertion of self-importance I had ever listened to and it fully prepared me for my trip through his shop a few minutes later, where I found no system, no method and no discipline. Every department was holding its breath waiting for "the superintendent" to say what it should do next, and Mr. Superintendent was kept pretty busy all day trotting round telling them what they might do.

No, Mr. Draftsman, I am not going to have any of you chaps standing round waiting for my permission to think. You just keep thinking on paper and as lively as you can and I will criticise and alter afterward. You will not like all of the changes I make in your work and you may also think my ideas not so good as yours, but that will put more manhood and independence into the marrow of your mental frame which will make you better. Life will be easier for me which will make me better, and the firm will make more money which will make them better. See?

Oh! You are the young man that was fitting the chuck. Have you got all ready to test the truth of the machine? The chuck plate is on about four threads and is stuck fast and you don't know an easy way to get it off without stripping the threads on the spindle? Well, there are several easy ways to get over that difficulty, but you go to Henry, the young fellow on the big milling machine, and ask him how we got the cutters off when they sheared the keys and were "stuck" the other day, and go thou and do likewise, squirting a little kerosene oil on the "joint" first, and after you get it off please remember how and why it came off and tell your friends, not how you can get out of trouble in such cases, but how they may save the spindle threads of their new lathes. You will just about get that chuck plate off and the job all finished by whistle time and then we will try the machine after dinner.

Say, do you ever wash your face at the noon hour? You don't. Yes, I know you bring your dinner, but at the same time I would like for all my men to begin work twice a day with clean faces. The principal reason for it is simply that it makes the man feel better. The water washing away the grit and dirt makes him feel freshened and reacts against the results of the noonday lunch, helping to keep away drowsiness during the long afternoon and giving the firm a better man and consequently better work. That is what we want.

Now, we will find out what we know about the lathe. First, place a fine pointed tool in the tool post, point extending toward the headstock and dead in line with the live center, horizontally, and bring the tailstock up and bring the dead center in line with the live one in both vertical and horizontal planes, next knock out that live center and push the tailstock back 6 feet away from the headstock and take this inch-and-a-quarter stick which is 6 feet long and taper one end so you can drive it in place of the live center, so. The other end of the stick is flat and smooth. Now, bring up the dead center (after you have drawn the tailstock tight) until its fine point just makes an impression in the end of the stick. Now, we will bring the fine pointed tool into play and set it so it will just scribe a small circle on the end of the stick. If all things are correct as we hope for, the dot made by the dead center will be the center of the circle made by the tool: if that headstock spindle is on a bias with the ways, the dot and circle will be eccentric and it will be impossible to bore a true hole. What do we find? Almost perfect. Throw out your shipper. Always stop your lathe or machine when you talk. Don't try to do two things at once. It can't be done successfully. Yes, that machine is true enough for all practical purposes and for our work in boring. That stick we used, even as light as it was, being thoroughly kiln dried, sagged down enough possibly to make some error. If there had been a serious error, how would we have fixed it? Well, "we" would not fix it at all, but the maker of that tool would have sent one of his men here with some nice bars and by turning the headstock over and scraping the female vees in it at the diagonal corners, and repeated trial with the bars similar to our stick method, he would have brought things around true. The next thing to try is the strength of the machine and you will do that when you put in the first job of work. Remember, I am expecting some pretty strong evidence of its ability.

THE OLD MAN.

HOW TO PROTECT INVENTIONS.

BY J. J. SAND.

In a recent issue I am asked by J. E. Smith to suggest some method by which an inventor without means can get some benefit from an invention.

Since it is a subject that is of interest to every mechanic, whether with or without means, I will try to tell what I know about it. The first question that occurs to a man that has constructed something which he thinks is new, is, can he get a patent for this invention before some one else thinks of the same thing and obtains a patent? Perhaps he goes at once to file a caveat in order to cover the invention temporarily. On general principles this is the wrong step. A patent obtained hurriedly is of no value and only throws the invention away. A caveat is not considered of any protection to a man without means.

The first step after having discovered something new is to show it to a number of friends and ask them to remember the date. Don't ask their opinion of it, for as a rule a friend's expressed opinion regarding such matters is of no value. In choosing the friends to whom you are to show your invention do not select a man who has taken out a large number of patents and has the reputation of a "shark." Many men have a desire to get every thing within their reach, and will stoop to very mean methods to secure the property of another. Don't be afraid of the true inventor, no matter how many patents he has secured. As a rule it is best to select a few shopmates.

After having thus shown your invention you are quite safe in letting any one see it. The next step is to get up a few working models or a tasty drawing and send these to some manufacturer or take them if convenient and set forth the advantages. If you can not get a manufacturer interested in your scheme it is of no value to you, and money will be thrown away which is used to obtain a patent. Having interested one or more manufacturers close a trade for the best price obtainable. Don't try to get the earth for an invention that has not been tested on the market. If you have invented something that is out of your line of experience, go slow. Don't put any money in it. The Louisiana Lottery is a better place for your money, for you will stand a much better chance of getting a return. The time has gone by when an inventor can hope to discover a great improvement in any class of work with which he is not thoroughly familiar.

Another side of the question which must always be considered is the market. Will the invention sell? is the pertinent query. Many meritorious schemes are of no value because there is no way to induce the manufacturer to produce them. For instance: Some thirty or forty years ago a certain man invented a quick-opening envelope which was opened by pulling a string. It would increase the cost of making the envelope a trifle but would be a great saver of valuable time when used and would be thoroughly appreciated by every one that received it. The inventor doubtless expected to reap a fortune, but was disappointed to find that the party interested in the scheme was not the one that bought the envelopes. He was the receiver and not the sender. Since that time this scheme has been re-invented, probably about once each month.

Each particular invention seems to have its own peculiar advantages and disadvantages on the market. It must be far superior to everything else or it must be made and sold for a smaller price. Both are generally necessary.

Exceptions will be taken to my views regarding the importance of using every effort to get a manufacturer interested before obtaining a patent or before making application for the same, but nevertheless the inventor is quite as safe before a patent has been obtained as he is afterwards. If a wealthy corporation desires to appropriate an invention of another without paying for the same they will do it, whether the scheme is covered or not. Manufacturers in general will do no such thing, but will secure the right by purchasing it.

The manufacturer has generally more experience in obtaining patents and will see that the invention is covered as broadly as possible.

Any patent obtained through any of the various patent agencies is of no value unless the claims are made out by some persons well up in the particular branch of art to which the invention belongs. Drafting the claims, requires as much inventive skill and foresight as was required to produce the scheme, and without great care is spent in the preparation of the claims an application simply throws the invention into the hands of the public.

Everything that is shown and described in a patent that is not covered by claims is made public property. Patent agencies that promise to procure a patent for a fixed price before seeing the invention, may be set down as frauds. Very few inventions can be properly shown and described for twenty-five dollars, which is the usual attorney's fee asked by the average agency. These agencies will offer to obtain a patent for sixty dollars. Some set it as low as fifty-five dollars. Others will guarantee to obtain a patent for that sum, and if no patent is issued they make no charge.

Almost any agency is good enough if the claims are drawn up by the inventor, for the tendency of these agencies is to draw very narrow claims, so that a patent will be speedily granted and they get their money, which is of course all they are after.

The claims should be drawn in the broadest possible manner, so as to cover any that might be made to take the place of the invention. After the claims are draw up, the inventor should use his best efforts to devise some scheme for getting around the claims. He should put himself in the position of the manufacturer, who, in looking over a patent, tries to think of some way in which the same result may be obtained without infringement. If the inventor finds a loose place in his claims then he must try to make a change in the wording that will cover both the original invention and that which he devised in trying to evade the wording of his claims.

Nearly every machinist is competent to make out an application for a patent for simple devices which do not require much drafting.

Full instructions for making application may be obtained by addressing the Commissioner of Patents at Washington, and asking for a copy of Rules of Practice and Patent Laws. These are furnished for the asking.

Patent agencies that are run for the money regardless of good name, will guarantee to obtain a patent on almost anything. Of course a narrow patent is of no value, but that is not all. It is worse than no patent, because it is misleading. Any hopes built on the success of the invention will meet with disaster. Any money put into developing and building the article may be lost. No manufacturer will take hold of any such invention because he does not know whether broad claims would conflict with other inventions or not, and if there is no question in his mind about the possibility of infringement on some other patent, he feels that a weak patent is a poor protection, and that it will not pay to advertise and work up a good market for something that others can copy.

The manufacturer is generally a very safe person to whom to show an unprotected invention. He will not put much money into any invention till he has procured a right from the inventor.

THE enterprising Lumkenheimer Brass Mfg. Co., of Cincinnati, O., are preparing for the World's Fair a most elaborate display of their popular specialties in valves, sight feed lubricators, oil and grease cups, etc. They will also exhibit a complete line of brass and iron goods, besides some novelties in steam whistles and sight feed lubricators. They report business exceedingly brisk, being crowded with orders for their numerous specialties and receiving large contracts for special work for United States Cruisers. Write them for circulars of their improved specialties.

THE Lodge & Davis Machine Tool Co., works, Cincinnati, O., have just closed a $7,000 contract with the Northington Munger Pratt Co., of Birmingham, Ala., for their improved machine tools, to be used in their new shops for the manufacture of cotton ginning machinery.

42-INCH BORING AND DRILLING MACHINE.

The Lodge & Davis Machine Tool Co., Cincinnati, O., have designed and are now building the combined boring and drilling machine herewith illustrated. This machine contains all the features of their improved standard drill presses combined with boring attachment. By simply engaging the table driving mechanism it becomes a complete boring machine and is designed for boring a large variety of articles, such as car wheels, large pulleys, sprocket wheels, mill gearing, etc.

The machine is designed for extra heavy duty, and is massive, rigid and simple in construction, and contains an abundance of metal distributed in a manner to secure absolute stiffness. It is heavily braced from the top to base at the rear which prevents the column from being forced backward during the strain of heavy boring or drilling. The cone pulleys are of large diameter and width of face and are placed far apart which permits the use of a long belt and materially increases the power. The back gearing is large and of a coarse pitch cut from the solid and is thrown in or out by a simple lever movement.

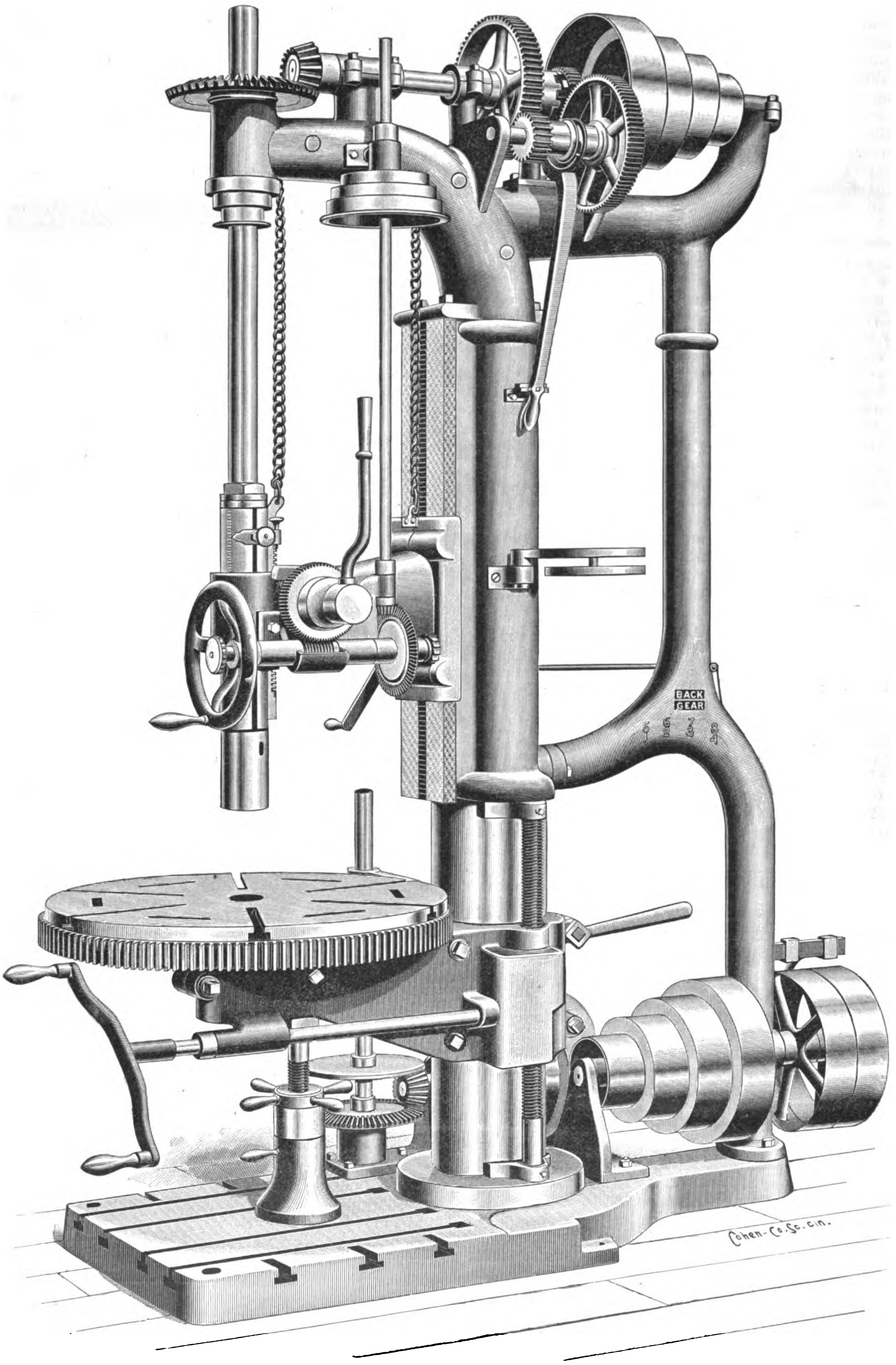
The power feed is operated from the front of the machine and is furnished with an attachment which automatically stops the feed at any desired point which may be indicated by a pointer and graduations on the spindle.

The patented quick return is placed on the right hand side of the machine thus allowing the left hand of the operator free to hold his work.

The head is balanced and gibbed to the face of the column, and it is raised and lowered on the column by means of rack and pinion.

The spindle is balanced, is made from large diameter steel and has a long bearing in the sleeve with provision for taking up the wear.

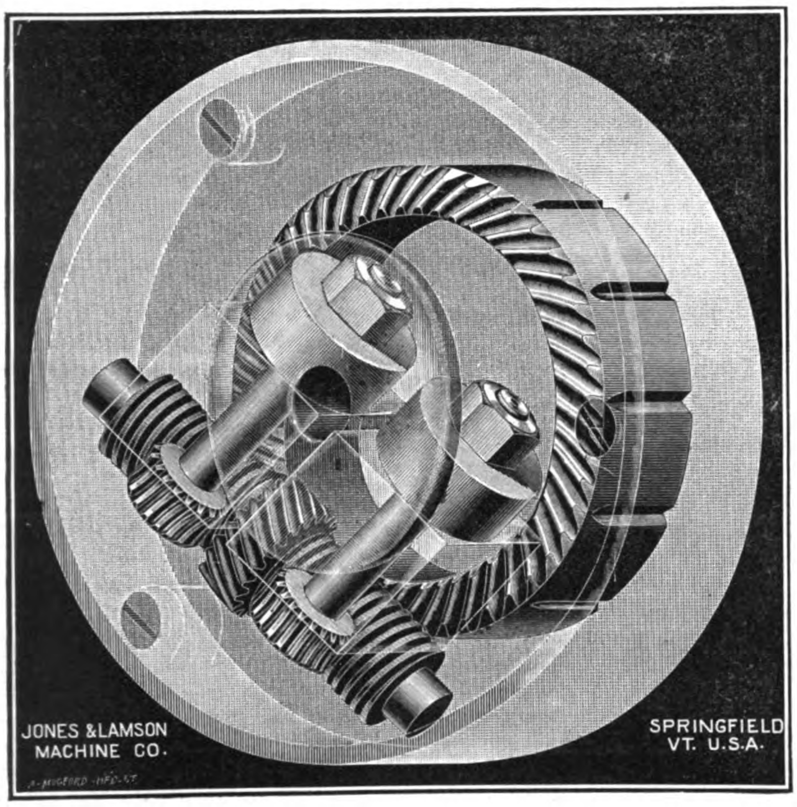
The table is raised and lowered from the front and can be swung around the column so that large work may be bolted directly to the base. The table driving mechanism is very powerful and is driven by a separate countershaft with four changes of speed and it is intended that the table should revolve in an opposite direction from the spindle. The driving gears are all covered to protect them from breakage. As an additional support to the table under heavy work a large jack is used with steel screw which is adjustable to various heights. An index is placed on the back brace and on the front arm which indicates the exact speed to use for operating on the various metals to the best advantage. This machine is fitted up with the best of workmanship and is capable of doing the most accurate work. The machine was designed by Mr. Henry Dreses, chief designer for the builders.



42-INCH BORING AND DRILLING MACHINE.

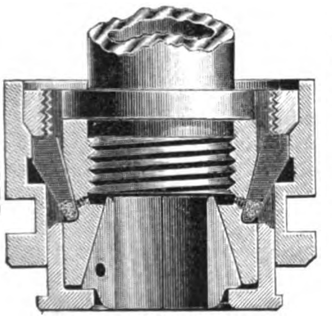
SOME DETAILS OF THE JONES & LAMSON FLAT TURRET LATHE.

There was recently published in this paper a partial description of the flat turret lathe brought out bo the Jones & Lamson Machine Co., of Springfield, Vt. Some of the interesting features we were unable to show.

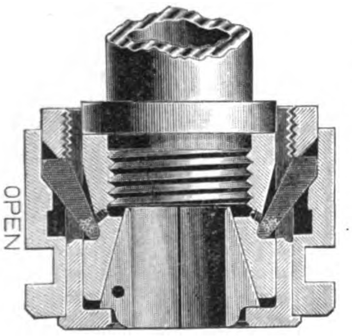

JONES & LAMSON MACHINE CO.
SPRINGFIELD VT. U.S.A.

ROLLER FEED.

This machine was especially designed for the rapid and accurate production of work such as is usually done on an engine lathe. The immense saving that can be made on this class of work when done on this machine is apparent when we see that it combines the accuracy of this engine lathe with the rapid production of the turret or screw machine. A part of the equipment of this lathe is their patent roller feed and automatic chuck which enables the operator to bring out a new length of work through the spindle without stopping the machine. The feed and chuck are both operated by the same lever. The accompanying cuts show the chuck and feed. The lever at the left of the chuck lever, enables the operator to throw the back gears in or out while the machine is in operation, giving with the triple friction countershaft, a great range of speeds. A rotary oil pump supplies a continuous stream of oil to the tools, thus increasing the economical cutting speeds.


CLOSED

OUTER SLEEVE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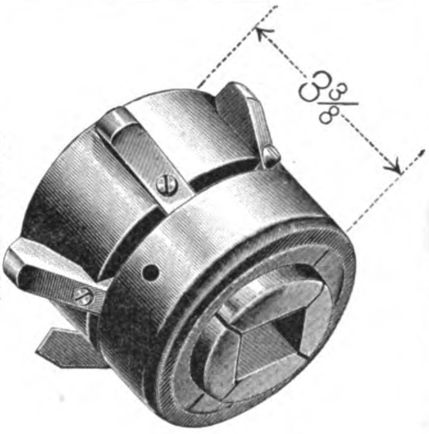
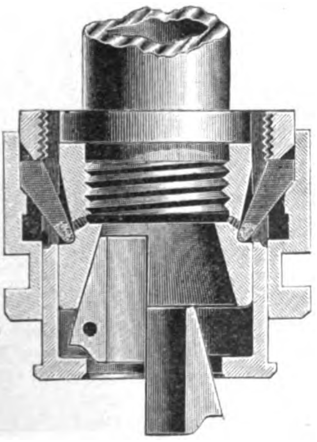
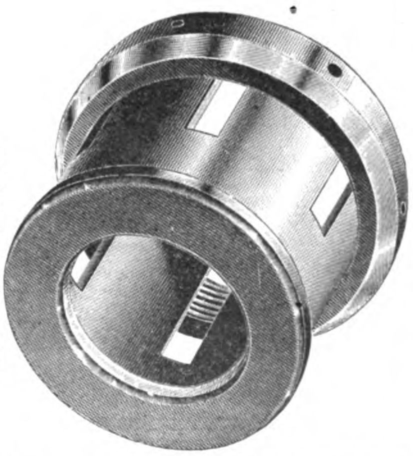


CHUCK BODY


REMOVING JAWS


INNER SLEEVE AND ADJUSTING COLLAR

Parties desiring detailed information will find it in their book entitled, "Rapid Lathe Work by a New Method," which is mailed free to any one who will address Jones & Lamson Machine Co., Box 61, Springfield, Vt.

PERPETUAL MOTION.

BY "THE OLD MAN."

"Inquirer", in your last issue, asked for some information on the above subject and, while I am not a walking encyclopedia on the matter in hand, I have had some little experience regarding it. Not that I ever believed there was anything in it, but natural circumstances brought it in my way.

When I was an apprentice, long time ago, a man came in the shop one day and asked for a "mechanic" to assist him at his house on a machine he was making. He wanted a man who could keep things to himself, and did not want a high priced man either. The proprietor chose your humble servant to go on the job. Why, I will explain later. Well, I worked for that chap nearly two months. The machine was only to be the size of a common churn, but it grew and grew with its multitudinous groups of wheels, levers, pulleys, gears and springs until it filled our room, with just space enough for us to walk around it and not crowd the wall out, and still it failed to go. We just lacked one more lever or spring, I've forgotten which. Then the inventor drew a sigh of despair and gave up. I went back to the shop and he settled up with the proprietor at the rate of forty cents an hour for my services. I got four dollars a week. See why the boss put me on the job? That was the most profitable perpetual motion I ever saw.

I have seen a fairy story in print about one being in the Patent Office that has run for twenty years or more, but my most careful inquiries among those intelligent public servants within that beautiful structure, where worthless claims are put out to be fought over and infringed upon, failed to produce the machine.

The oldest perpetual motion, to my knowledge, on record was got up by a woman named Eve in the year one of creation, or several thousand B. C. It was in the form of an apple and she gave a half interest in it to a man named Adam. A chap called the Devil was a silent partner in the concern. It was a clean infringement though and they all got fired, and her heirs and assigns have been having perpetual motion ever since. (See Genesis, chapter 1, 2, 3, 4, 5, and 6.)

The man who tries to put the steam back in the boiler, after using it in the engine over and over again, is probably the most diligent crank on the subject.

One day, a few Summers ago while riding on a Western road, a sleek looking chap with a clerical air and a shiny tile dropped down in the seat beside me, called me by name and asked if I knew him? Answering in the negative, he handed me his card. It read thus,

AMERICAN COMPRESSED AIR LOCOMOTIVE CO.
Lunaburgh,
Ohio.
ATHOLPORUS BLANK, *Pres't and Gen'l Manager.*

and then I knew him. Blank at one time years ago was a fireman on a road on which I was running, and "resigned" because he spilled half a tank of coal every trip trying to get the other half into the furnace door. With many flourishes of his silk plug he explained that his compressed air locomotive carried a number of air pumps connected to the axles, and only coal and steam enough to get the train away from the terminal point was all that was needed. By that time the air pumps were at work and storing air in the boiler for all future work. Instead of explaining to the lunatic that he would always be one pump short, I fell into his mood and asked him to equip my stationary engine with his device, as I wanted to run constantly double turn and do away with my engineer, and illustrated to him clearly that he had discovered perpetual motion. Thanking me for my kindness, he took the next train back to Lunaburgh to lay the whole matter before his company and let them see his great discovery. Three years after I was in a planing mill trying to help the owner get full power out of his engine and I found Blank "tailing" a planer. He wasn't one bit sociable and said, "as soon as he laid the perpetual motion scheme before his capitalists they gave him the 'cold shake,' and it was all my fault."

A farmer in Posey county, Indiana, got up a good idea for perpetual motion some years ago, but had the misfortune of being too sensible to patent it. I made the drawings of it, and as it is public property any one can try it.

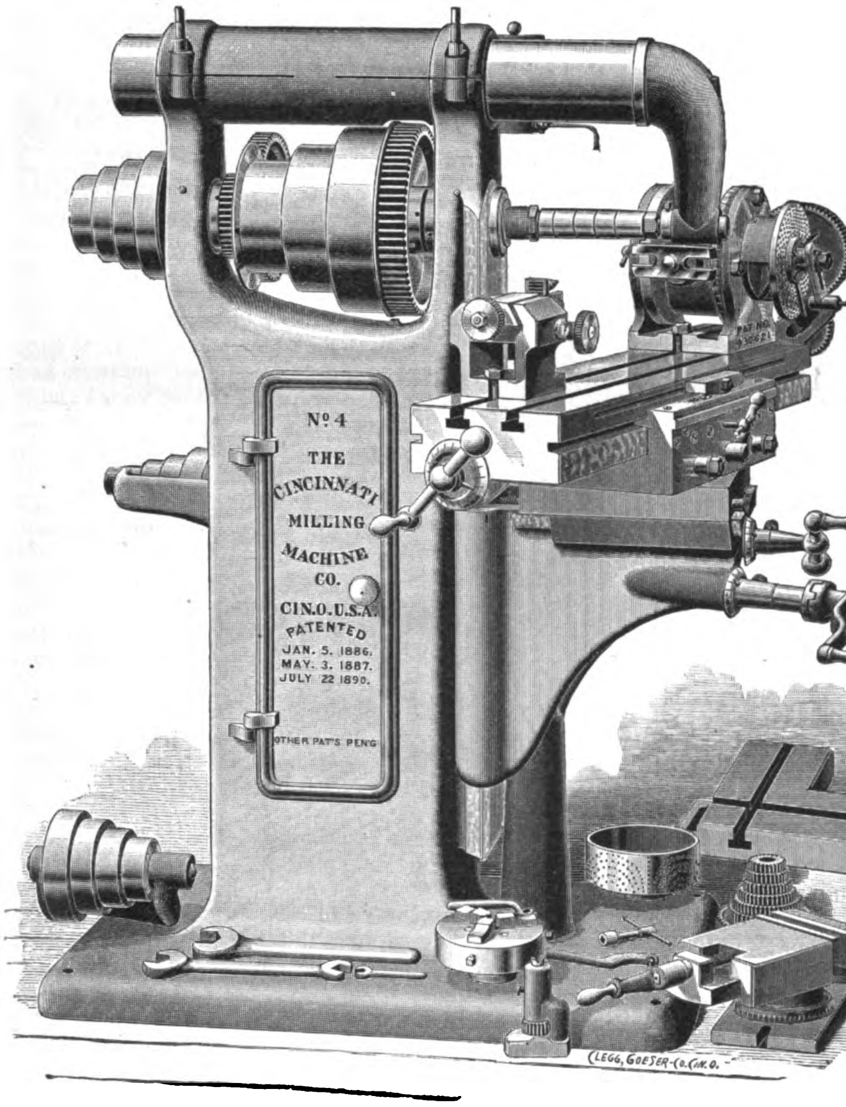
Four bars of equal length are fixed on a shaft in bearings and four figures 6 are rigidly fixed on the ends as shown. It is easy to see that when once started, the figure 6 at the bottom becomes a 9 at the top and as nine is one half more than six and overbalances it, the 9 will come down and the next 6 becomes a 9 and so on *ad infinitum*, *E pluribus unum*, or so to speak.

This is the only way I know of to figure out something for nothing.

A GERMAN paper states that Messrs. Siemens & Halske, of Berlin, have succeeded in producing a new telephone cable which the Bavarian telegraph authorities consider as an important advance for the introduction of the double wire system. The cable is suitable for long distance telephony.

UNIVERSAL TOOL ROOM MILLING MACHINE.

We present herewith illustration of a heavy universal milling machine as built by the Cincinnati Milling Machine Co., of Cincinnati, O. This firm are making a specialty of milling machines. Their design embodies modern features and the workmanship is of the best grade. The machine shown is a heavy stiff tool with every feature of a universal tool room milling machine.



UNIVERSAL TOOL ROOM MILLING MACHINE.

The platen is 9½″ side, 47″ long, with an automatic horizontal feed of 25″, and a quick return motion of three to one. A new and important feature on this machine is the intermediate pulley on base of machine by means of which twelve variations of feed to platen are obtained for every spindle speed. The universal indexing and dividing head is entirely new in its design and has a number of valuable features. It is the most rigid dividing head made. The swiveling block can be swung on either side of vertical line, allowing work to be held in the most favorable position for rapid and smooth cutting. The tail block has a patent elevating center bar which is used to an advantage on taper work.

Features worthy of special attention are the form of column, having two upright supports of overhanging arm connected by a brace, stiffening the entire frame; the cylindrical overhanging arm with its advantages of quick and easy removal; long and wide bearings of knee on column and saddle on knee; the manner of withdrawing arbor by means of nut and thread, instead of using rod or drift, and the convenient arrangement of cranks and handles for making the various adjustments on machine. Each screw is provided with a dial indicating the adjustment in one-thousandths of an inch. The machine is furnished complete as shown, and weighs 2,900 pounds. For details address the makers.

A GREAT CENTER FOR WOOD-WORKING MACHINES.

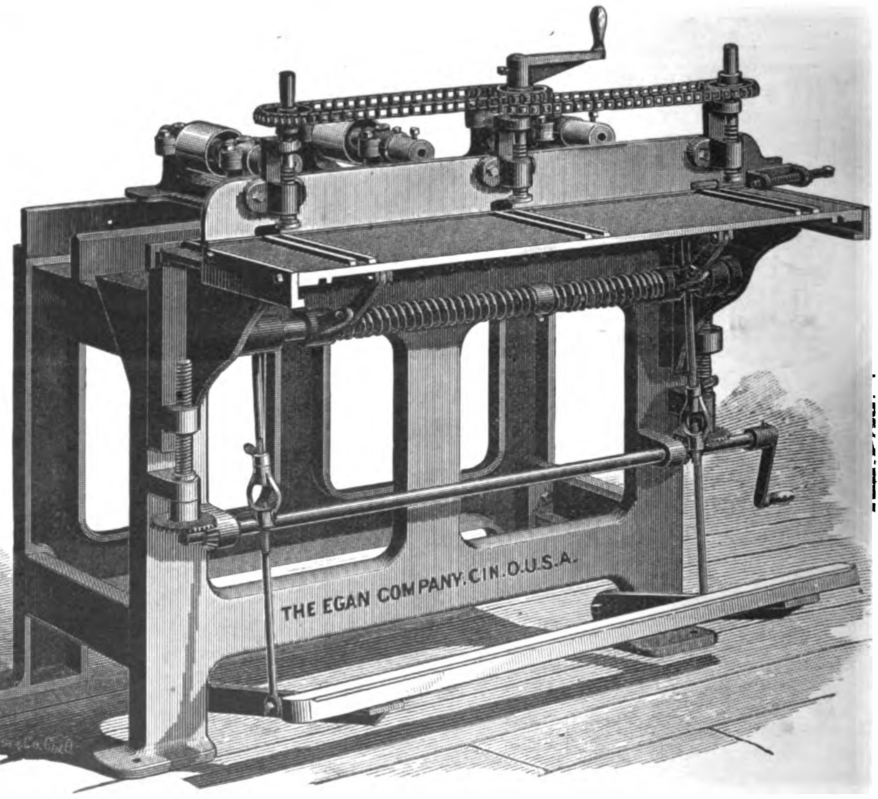
In a recent interview, Thos. P. Egan, President of the Egan Co., of Cincinnati, O., one of the most extensive manufacturers of wood-working machinery in the world, made this statement: "Cincinnati may well feel proud of her commanding position as a manufacturer of machinery. In 1864, when I first went into this branch of manufacturing, the business was very small and very contracted. Not 200 men were engaged in it, and the machines were wood frames, and the most of them made to order as the operator wanted them. Now there are fully 5,000 men in this and kindred lines, and the machines are all of iron and steel. The designs and improvements are superior and are so sought after that foreign governments stipulate in their requisitions: 'Machinery from Cincinnati or equal to it.' It has been remarked that on account of the great reputation of two concerns in this city, they brought buyers from all parts of the world and allowed several of the smaller concerns to grow up and improve. In the recent flurry in Chili, the government of the United States wanted a full outfit of machinery for the Navy yard at Norfolk, Va. and wanted it at once. By special contract, Cincinnati again carried the day and filled the order for 32 machines, made by the Egan Co. At Paris, Vienna and London, Cincinnati concerns carried off the honors. Our company has made application for 20,000 square feet of floor surface in machinery hall, in order to display some 40 different machines of our own construction and origin, all in operation."

The cut given herewith is of the Egan Co.'s multiple spindle boring machine. It is designed for accurate and rapid boring, being specially suitable for table leaf work, furniture work, agricultural implements, etc The frame is of iron, well braced, and planed perfectly true. The mandrel frames slide on planed ways, each outside mandrel frame is independently adjustable to and from the center mandrel, and each mandrel is driven by an independent belt. The table works on planed ways and is raised and lowered by bevel gears and screws operated by a crank and parallel shaft below. The treadle is connected to the table by adjustable rods to regulate the throw of the table, which is brought up to the boring bits when the treadle is brought down, and when the treadle is released the table returns to its original position.

The clamping device is entirely new, all three screws being operated by one crank handle in the center. One-quarter of a turn of this handle gives ¼″ movement to the screws clamping the stock down to the planed surface of the table, and in connection with the end stop it is impossible to bore holes out of line. It is specially adapted to extension table works. The machine can be made with one or more spindles; as a multiple borer it will bore from 4″ any required distance apart.

Basic Steel For Shipbuilding.

While basic steel has been found in every way suitable for the manufacture of rails, and has been generally so acknowledged, its adaptability for the production of plates and angles used for shipbuilding purposes has only been demonstrated within a comparatively short time, but shipbuilders are yet backward about regarding it with the favor that attaches to plates made from hematite. Basic steel angles, in every respect equal to those produced from hematite steel, are made regularly in this country, and it is said that a considerable quantity of basic steel plates has been turned out in Germany for shipbuilding purposes, but in Great Britain the tonnage so made and utilized has so far been small. It is rumored that in order to prove the entire suitability of basic steel for shipbuilding, a company is being formed, to be known as the Basic Steamship Co., which will have a steam vessel constructed altogether of this material, and we understand that one of the north of England steel-making companies has undertaken to supply the materials, which will be constructed to pass Lloyd's usual tests. It is contended that there is no more difficulty in producing such basic steel than there is in making ordinary hematite steel. In Germany the virtues of basic steel are fully demonstrated, it being made as cheaply and readily as hematite steel. There, of course, the difference between the cost of materials is greater than it is in this country, for the iron ore imported from Spain has to be conveyed further inland, the steel works being further away from the seaboard than in England, while materials for basic steel making are close at hand. For this reason it is in Germany that the greatest development of the basic process has been witnessed. No doubt in this country greater quantities of basic plates would have been made if there had been a demand for them, and if the prejudices of shipbuilders and shipowners had been overcome. It is upwards of a year since testimony was forthcoming at a meeting of the Cleveland Institution of Engineers that basic steel plates could be produced with as little difficulty as hematite steel plates to stand Lloyd's tests. At this meeting were present, among others, Mr. W. H. White, representing the Admiralty, and Mr. Martell, of Lloyd's.—[London Colliery Guardian.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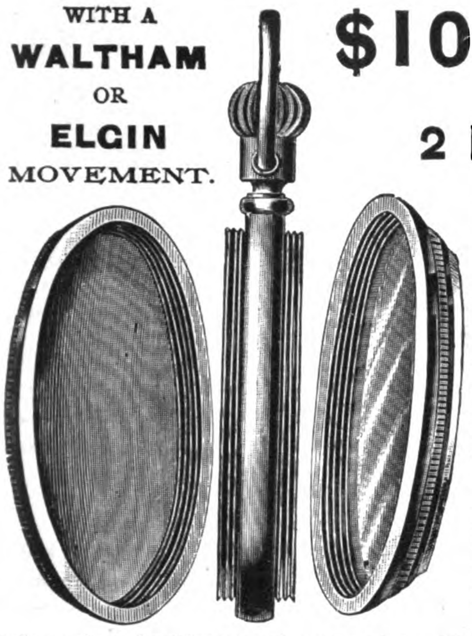

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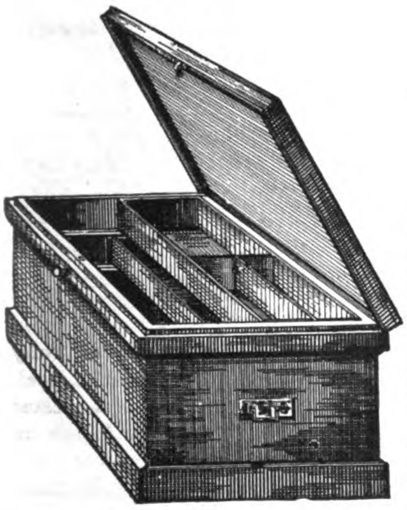

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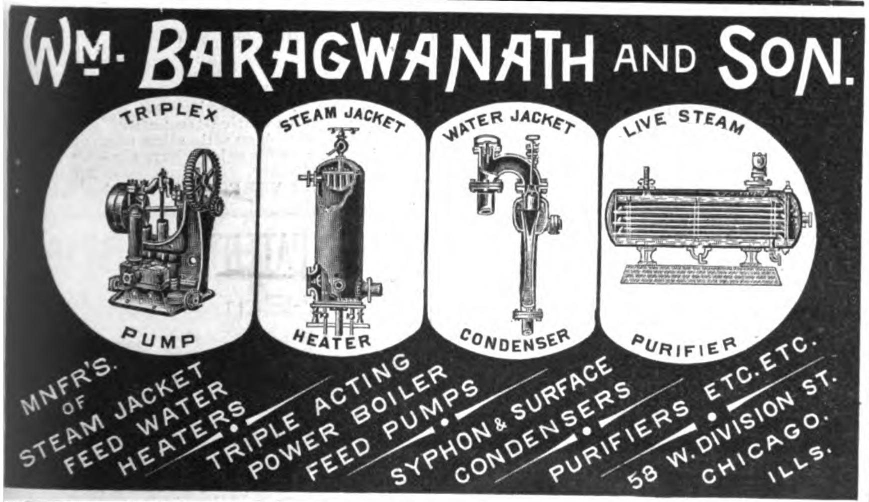
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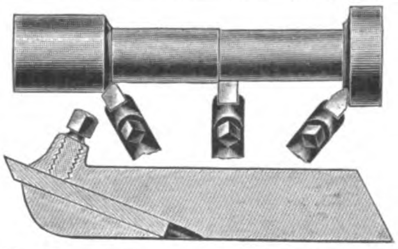

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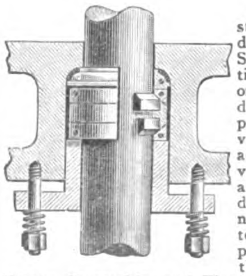

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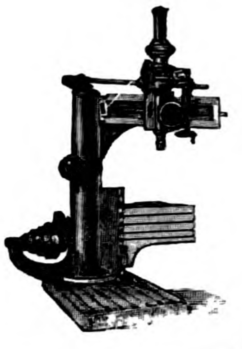

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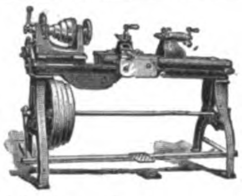

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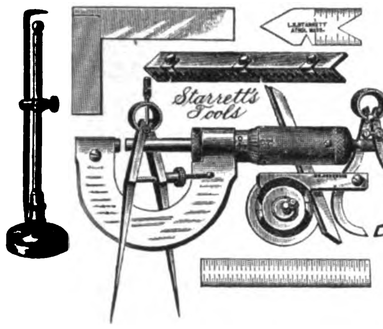

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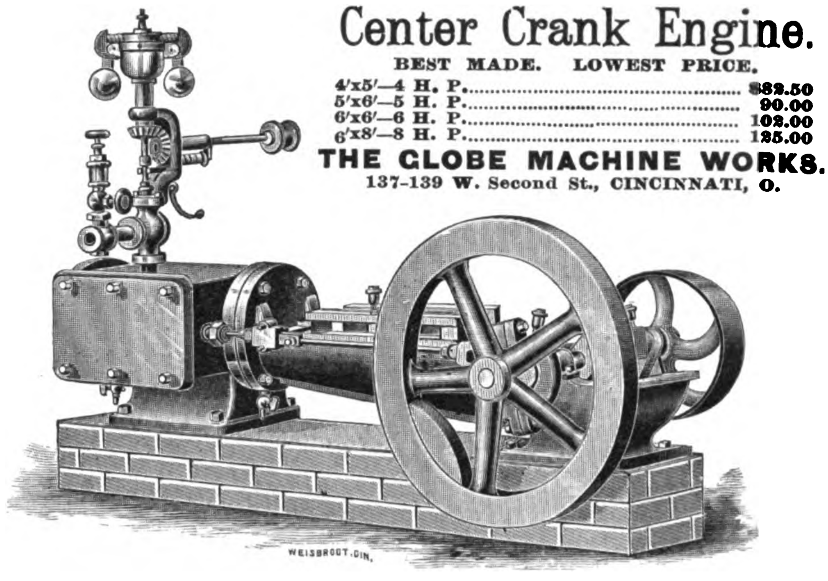

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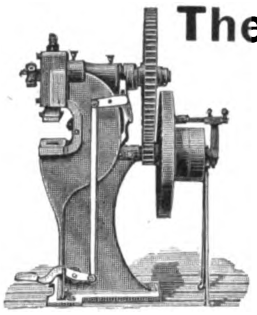

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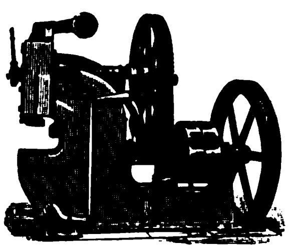

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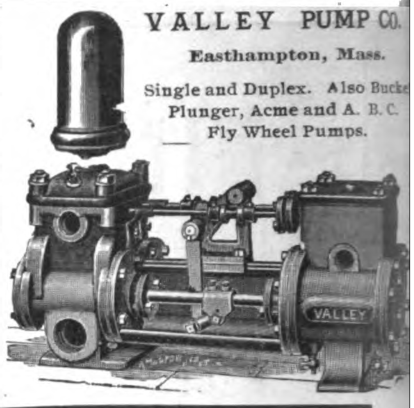

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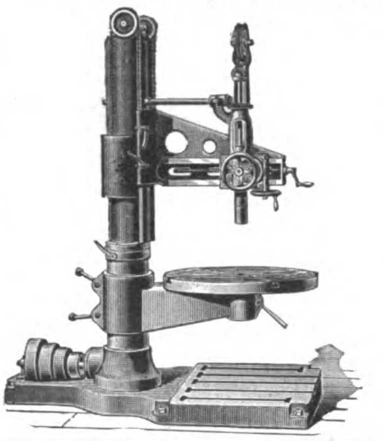

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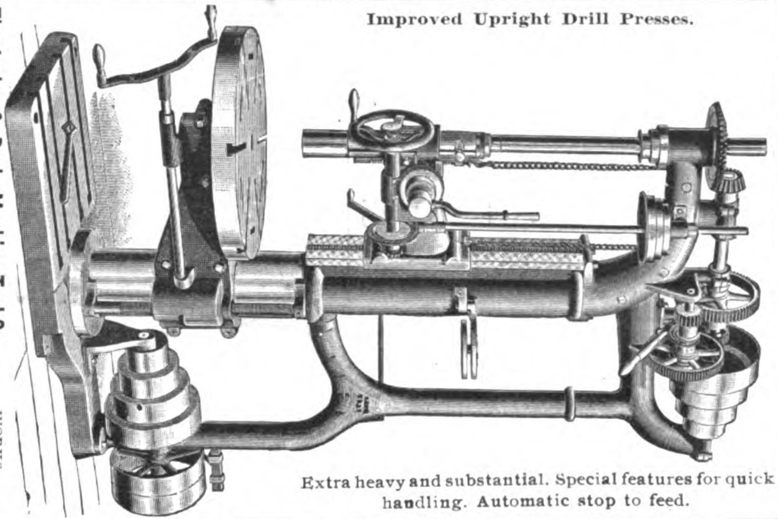

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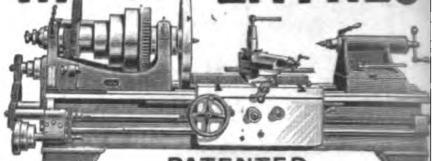

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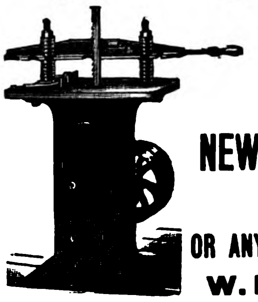

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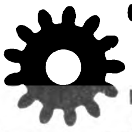

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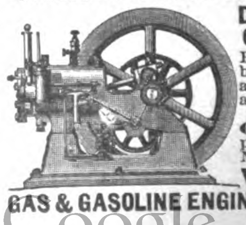

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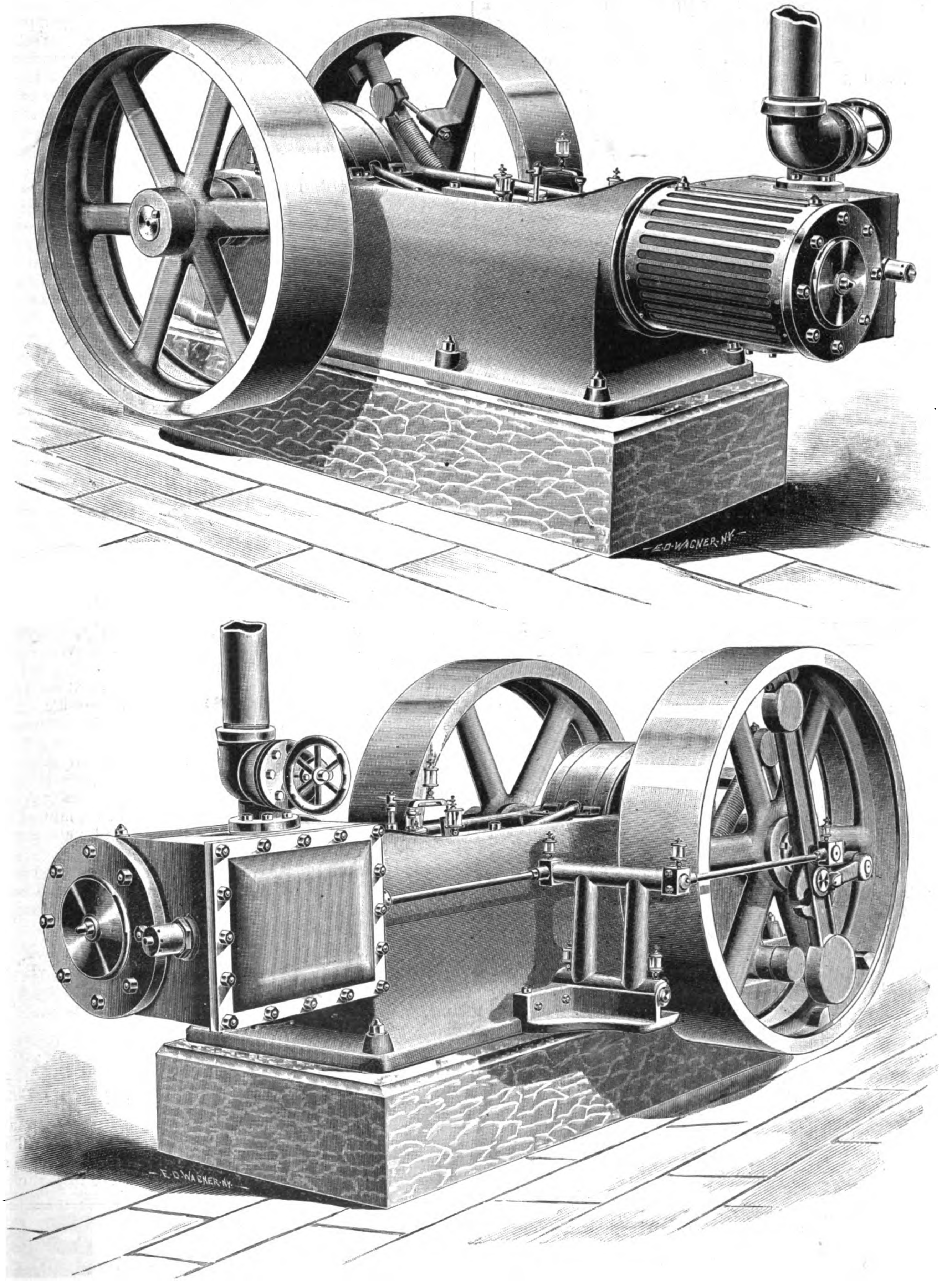
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(Continued on page 8.)

STEAM PUMPS.—III.

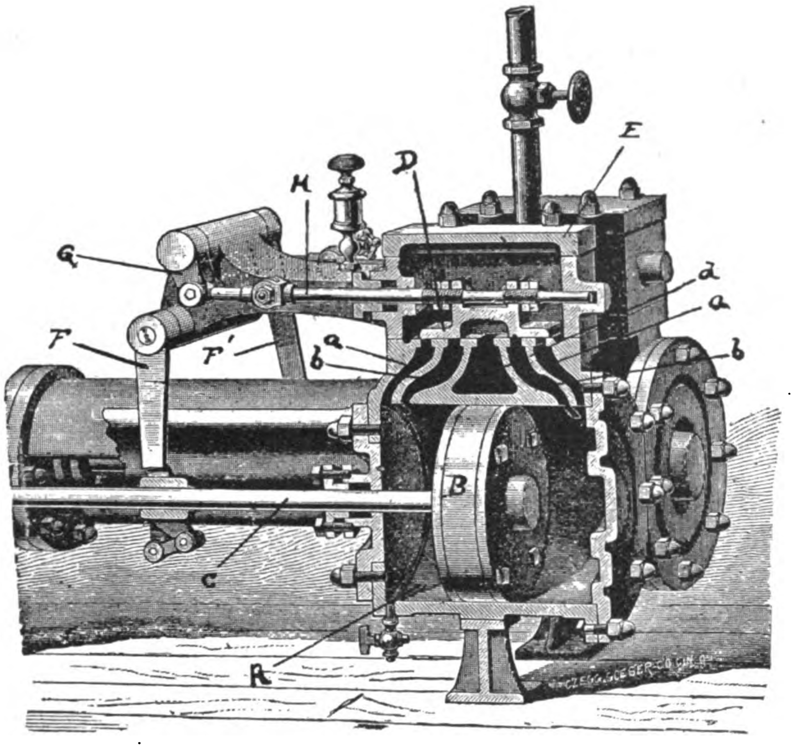
BY J. C. SMITH, M. E.

In our last article the method of computing the capacity of a single pump was dwelt upon, and the diameter of the water piston to deliver a certain amount of liquid, in a given time, was obtained. It would now be in order to find what diameter of steam piston is required to force this liquid to a certain height.

Let us assume that in the example of the previous article, the pump is required to force the liquid a height of 230 feet, and with the steam pressure of 60 pounds to the square inch.

Now, it was found that in order to move 200 barrels per hour, at a piston speed of 100 feet, it required a piston 6⅜″ in diameter; or one whose area is equal to 32.7 square inches, and it is now required to find the static pressure exerted by this column of 230 feet upon the water piston whose diameter is 6⅜″.

It was demonstrated in the first article of this series, that a column of water 33 feet in height and 1 square inch in cross section, is equal to a weight of 14.7 (14 7-10) pounds; therefore, the pressure per square inch on a column of water 230 feet high will be equal to 14.7 pounds multiplied by the number of times which 33 feet is contained in 230 feet; that is, 230 ÷ 33 = 6.97, then 6.97 × 14.7 pounds = 102.5 pounds, or approximately 103 pounds, which is the pressure per square inch of a column of water 230 feet high upon the water piston. Since the area of the water piston is equal to 32.7 square inches, the total pressure on water piston will be equal to the product of the pressure per square inch by the number of square inches, or 32.7 × 103 = 3,368 pounds total.



It should be remarked here that the specific gravity of the liquid should be known, at least, approximately; for in some cases it would make a great difference in pressure from that already calculated.

The specific gravity of a substance is the comparison of the weight of a certain volume with that of an equal volume of pure water, and is represented by the number of times it is as heavy as the volume of water.

Thus the specific gravity of alcohol is .79, or about 8-10 as heavy as water, which would make the pressure of the column equal to 3,368 × 8-10 = 2,694 pounds; the specific gravity of sulphuric acid is 1.84, or 1 84-100 times as heavy as water, which would make the total pressure in this case equal to 3,368 × 1.84 = 6,197 pounds, which would be the pressure total if the liquid to be moved were sulphuric acid. The cases are simply used for illustration and rarely if ever occur, but still it is well to know approximately, at least, the specific gravity of the liquid to be moved.

Since we have found the static pressure (pressure of rest) to be 3,368 pounds, it follows that, in order to sustain this pressure on the water piston, the total pressure on the steam piston must be equal to it; and, in order to set this column of water in motion, and to overcome the friction in the stuffing boxes, piston packing, etc., as well, an increased pressure is necessary, and in order to accomplish this safely 25 per cent. or ¼ of the total pressure is added to the total pressure itself, which in this case would be 3,368 + 842 = 4,210 pounds, which must be the total pressure on the steam piston.

Since the pressure per square inch on the steam piston is 60 pounds, the number of square inches required in the steam piston to give a pressure of 4,210 pounds will be 4,210 ÷ 60 = 70.1 square inches, which is equal, approximately, to the area of a circle whose diameter is 9½″; therefore, the diameter of steam piston required is 9½″.

The dimensions of the single pump required to force 200 barrels of water 230 feet high, per hour, at a piston speed of 100 feet per minute, with a steam pressure of 60 pounds, are 9½″ steam cylinder, 6⅜″ water cylinder by whatever stroke which is the most acceptable, which in this case would be about 12″.

These computations refer to single pumps only, although when duplex pumps are considered the same computations are applicable, remembering that the duplex pump is but really two single pumps placed side by side. The area of the water piston would therefore be reduced by nearly one-half, the steam piston also being reduced accordingly.

A duplex pump, whose water pistons are equal in area to that of a single pump, cannot deliver twice the volume of water as the single pump at the same piston speed, as in the peculiarity of the duplex motion, one side makes its stroke and has a short period of rest, until the other side changes the direction of motion, while in the single pump the change in direction of motion is accomplished at once without rest.

The accompanying cut is an excellent representation of a duplex pump, in which one side is shown in section: A representing the steam cylinder, B the steam piston, C the piston rod, through which the pressure on B is transmitted to the water piston. From the cut it will be seen that there are two pumps side by side, in which the steam cylinders have one steam pipe in common together with but one exhaust.

It will also be seen that the steam valve D is driven by the valve stem H, which is connected by means of a link to the rock shaft G; to the other end of the rock shaft G, the rock arm F is fitted, the lower end of which being attached to the piston rod of the pump on the opposite side, the same valve connections are also made from the steam valve of the opposite side to the piston rod of the side shown in section.

The object of this method of connection is to overcome the difficulty of moving the steam valves D at the dead points of the stroke, and which was dwelt upon, in the previous article, on single pump valve motion.

In the duplex pump the difficulty is overcome as follows:

When the piston B of the side in section is in motion it drives the arm of F, which drives the steam valve of the opposite side which has reached one of its dead points and is unable to move until its steam valve is thrown.

The piston B moves on carrying the steam valve of the opposite pump with it, until sufficient steam is admitted to start the piston on the opposite side, which then carries the rock arm F with it, and moves the valve stem G with it.

The piston B, of the side in section, still moves on, until it reaches the end of the stroke, or its dead point, where it remains with steam port A open, until the piston on the opposite side has moved sufficiently far to close the port A on one end and open it on the opposite end. The piston B of the side in section then starts in the opposite direction, and through the rock arm F, moves the steam valve of the opposite side; the opposite piston has, by this time, reached the end of its stroke, and remains at rest, waiting for its sister side to throw the steam valve, and start off in the opposite direction, which it does and passes on in its stroke until the end is reached. Here it remains, until the rock arm F, connected with the piston of the opposite side, shifts the valve D, starting the piston B back in the opposite direction.

In all cases, the crank shaft G has a length of motion greater than is necessary to move the steam valve D, which needs a motion but twice as great as the width of the port *a*. In order that the valve may move no greater distance than this, lost motion is left between the nuts on the valve stem H, and the lugs of the valve D, which is equal to the difference between the motion of the rock shaft G and the necessary motion of the steam valve D.

In setting the steam valve of the pump, move one side of the pump until the piston B strikes the cylinder head, then readjust the nuts on the valve stem H, so that the steam valve on the opposite side leaves the port *a*, full open; then move the piston B of the same side back to strike the opposite head, and move the other nuts on the valve stem H, until the opposite port *a* has full opening. Go through the same operations with the other side, taking care in all cases, that the travel of the valve is sufficient to give a full port *a*, and no more.

It will be noticed that there are two ports at each end of the steam cylinder, while the steam valve D has neither inside nor outside lap. It will also be noticed that, when the steam valve D is moved to the right, the left hand port *a* is uncovered, admitting steam to the left hand face of the piston B, and forcing it to the right; the left hand port *b*, is closed. On the right hand end the port *a* is closed, while the right hand port *b* communicates the right hand end of the steam cylinder A with the exhaust port *d*; that is, the outer ports *a a*, are used for admitting live steam to the cylinder A, while the ports *b b*, are used to allow the enclosed steam to escape into the exhaust.

After the steam piston has passed so far as to cover the port *b*, no more exhaust steam can escape; and, being imprisoned between the piston and the cylinder head, it serves as a cushion, keeping the piston from striking the head of the steam cylinder.

PROF. STOKES, of London, has lately demonstrated in an ingenious process of experimentation the long-supposed presence of suspended matter in flame, which has been a much discussed question among chemists, some holding to one theory and some to another. According to Prof. Stokes, the way this is optically proved is to condense sunlight on the flame, and the light is then scattered by the solid particles in an extremely thin layer, both where the beam enters the flame and where it leaves it; it is polarized in the flame of reflection. An interesting as well as singular fact is here exhibited, namely, that this effect is not found in all flames. It is found to be absent, for instance, in that of a Bunsen flame tinged with burning sodium; and in this case according to Prof. Stokes, the fact is due to the sodium being in the form of vapor instead of particles.

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Practical Letters.

De-Magnetizing a Watch.

EDITOR SCIENTIFIC MACHINIST:

I received your paper and books and they have gone far beyond my expectations. I owe you many thanks for them.

In looking over your last month's copy, I noticed a question about de-magnetizing a watch. There are two ways that I know of. One is by holding it half way between the field magnets (on the same side of armature) of the *live* brush of a dynamo, and the other is by hanging it over and very near a transformer for the effect of the alternating current.

The former way will take less than a minute, but with transformer perhaps half an hour.

F. A. MAYHEW.

What Helped Him Out.

EDITOR SCIENTIFIC MACHINIST:

Reading the article of F. A. W., P——berg, in your issue of April 15th, reminds me that I had a case of the same nature, but my engine is a Corliss, while his is a slide valve. You do not give a remedy for him. Now, let me state how I fixed mine. I took out the valve, mixed tallow with plumbago, put a good coat on the valve, rubbing in well by hand, put valve back in valve chamber, unshipped valve rod, worked valve forward and backward for a few minutes, turned on a very little steam, kept working for a few minutes longer, then shipped up and let her go, and I have had no trouble since.

F. L.

Shall the Engine Operator not be called an Engineer?

EDITOR SCIENTIFIC MACHINIST:

I would call a man who understands the running and construction of an engine, an engineer, as I consider that to him only belongs that title.

In the Spanish language, which is a good deal similar to the French, the stationary engine and locomotive are called "la maquina" or "maquina de vapor," and the operator is called "el maquinista." That is probably the reason French engineers are called machinists.

The professional man or civil engineer is called "Ingeniero." The word, I think, is derived from the Latin "Ingenio," meaning mental power, or genius.

Now, if we have a machine called an engine, let us call the operator and builder, a mechanical, locomotive, or stationary engineer. If there is any change necessary the professional man should stand it, as he works by his "Ingenio" or ingenuity—and may never have seen an engine. Call him an Ingeneer, which sounds a little Irish, but will be none the worse for that.

SALEM VIRGINIAN.

A Defense is it, or Vindication?

EDITOR SCIENTIFIC MACHINIST:

I do not, as a rule re write, and seldom discuss tangled problems, but M. C. Mac. is "in it," and has gotten myself and I do not know how many more in it, also. The gauge tester to which he refers is not elegant, but it is practical and perfectly reliable and accurate—and cheap—four desirable qualities. I use a pump for obtaining pressure, but the tester may be attached to a working boiler and the gauge tester without removing it—proceedings which often makes a new siphon necessary. His device is very neat—it looks well, and if it is set up perfectly plumb, the weights adjusted centrally, and the piston a good fit, it will be accurate. Its drawback is in the failure of any of these particulars, and in the small piston which equals a square half inch only. If the machine is not plumb or if the weights overhang, the friction will be excessive, and as the ratio of the gauge and piston is four to one, then five pounds friction on the piston would make the gauge show 20 pounds less pressure than it should. Presume M. C. Mac. means a gauge should register 40 pounds, instead of 50, with a ten-pound weight on the tester. But the air in the boilers is not considered. If my memory does not fail me, I believe I advised lifting the safety valve to test its working condition and to remove the vacuum, that the gauge cocks might indicate the water level. My observation has long since taught me that water will boil quicker without, than with a pressure upon it. Steam does not come till water boils. Hence the sooner it can be started to boiling and the water circulating the quicker steam can be raised. That is the sole object in letting the air pressure out. It may be a fancy, but I delight to encourage such fancies.

EDWIN WOODWARD.

A SUBMARINE CRAFT.

The Cleveland *World* printed recently a dispatch from Detroit stating that Mr. George C. Baker's submarine boat had been given a trial and was, in a great measure, a success. The New York *Herald* gives the following interview with the inventor, and a description of the novel craft:

"A few years ago," said Mr. Baker, "after a long illness, I went to the Pacific coast to regain my health. At San Francisco I was much interested in the harbor, with its constant stream of incoming and outgoing vessels, and on investigating the forts and the means of harbor defense I found them wholly inadequate for war purposes. In a few hours hostile war vessels could do untold damage to the city. While standing on the coast one day an idea came to me—not merely an idea that a torpedo boat should be constructed, but also the design upon which it should be built. Though it was some time before I began actually to work out my theories, I never forgot the almost revelation that came to me on the coast."

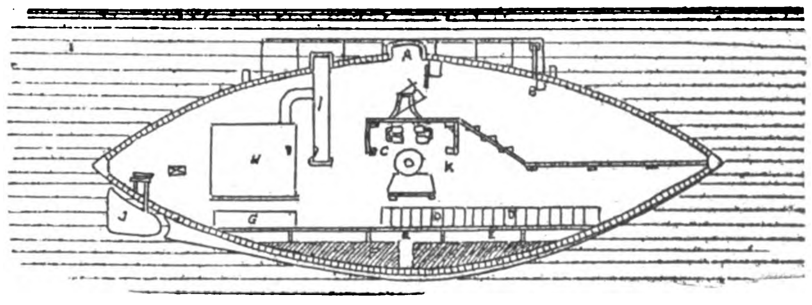
Mr. Baker constructed a small model which worked satisfactorily, and in December, 1889, he let a contract for his submarine boat to the Detroit boat works of Detroit, Mich. The work of construction was necessarily slow, as everything was new and experimental. Sometimes months would pass without visible progress, but all this time suggestions were being made and worked upon.

The chief delay was in the motive power, which had to be adapted to untried conditions. Mr. Baker came over from Chicago as often as possible to superintend the work and finally, after nearly two years, the hull, which then contained nothing but the boiler and engines, was launched at the foot of Orleans street, Detroit, last October.

Then came a long delay. Arranging the motive power and other machinery was tedious work, everything having to be made to order. People who had called the boat a piece of folly when it was launched now predicted that it would never be moved from its dock. In time the boat was given a trial with steam power, being able, of course, to sink no deeper than the height of the smoke stack. Under these restricted conditions the trial was a success.

The hull of the boat is 40 feet long, 14 feet deep and 9 feet wide; it is built in perfect curves, and a horizontal cross section shows a perfect ellipse. The hull is constructed of oak sections, 6" thick, laid with broken joints. This skeleton-work is covered with waterproof cloth, and is then planked lengthwise with 1" oak, the structure being capable of standing a pressure of 75 pounds to the square inch.

On top of the hull and directly in the center is the conning tower, 15" high, supplied with thick glass lights. The tower is fitted with a water-tight cover, through which entrance to the inside of the boat is obtained.



LONGITUDINAL SECTION OF THE BOAT WHEN SUBMERGED.

A—Conning Tower, wheel and Levers.
B—Air Pipe.
C—Dynamo and Engine.
D—Storage Battery Cells.
E—Compartments for Water Ballast.
F—Pig Iron Ballast.
G—Oil Tank.
H—Boiler.
I—Smokestack, drawn down for submarine navigation.
J—Rudder.
K—Shaft for Propellers.

In the rear of the conning tower is the movable smokestack of telescopic structure. About the same distance forward of the center is an air pipe through which the air is drawn by means of a powerful electric fan. The smokestack, conning tower and air pipe are surrounded by a light iron railing several inches above the water line at which the boat usually floats.

On entering the boat through the conning tower one finds directly under the conning tower a platform for the pilot, who controls the wheel that steers the boat and also the levers by which is manipulated the machinery that causes the boat to descend or to ascend. The deck proper is three feet from the bottom. The space beneath the deck is fitted with bulkheads, separating it into compartments which can be filled with water. There is also stored the necessary ballast. Water is let in from the bottom when the boat is to be submerged. On this deck are the boiler, engine, dynamo and batteries.

The Roberts marine boiler of 150 horse-power is located astern of the conning tower, oil being used as fuel. The engine is of a common marine build of 60 horse-power. The motor, placed directly under the conning tower platform, was especially constructed by the Jenney company. When not being used to run the boat it can be utilized as a dynamo to charge the Woodward batteries. There are 234 cells, divided into four series, capable of giving a force of 50 horse-power for four consecutive hours. The boat is thus equipped with a double motive power. When on the surface steam power is used. In submarine navigation, however, electricity is brought into service. The same cells that furnish the power also supply the incandescent lights, and by means of a powerful search light even the surrounding water can be illuminated.

The general shape of the boat is Mr. Baker's own idea, but its unique feature lies in the propeller shafts. The propellers are on cross shafts and are connected with the engine shafts by mitred gears. The whole works in a movable sleeve controlled by a worm gear by which the pilot can deflect the propeller shafts from the horizontal to the perpendicular at will. Mr. Baker's invention lies in the general construction of the propellers, which are situated exactly amidships at the sides of the boat. When the propeller shaft is horizontal the revolving wheels send the boat forward or backward. As the angle of the shaft is elevated or depressed the propellers carry the boat down or up at an angle corresponding to the angle of the shaft. At the same time the peculiar shape of the boat's hull keeps it perfectly horizontal and prevents its nose from running into the bottom.

George C. Baker, of Chicago, the inventor of the submarine boat, was born in Cook county, Ill., December 21, 1844. At 11 years of age his his parents removed to Polk City, Ia., where he lived until July, 1862, when at 17 years of age he enlisted in Company B, Twenty-third Iowa infantry. He served through the war until his regiment was mustered out at Harrisburg Tex., in September, 1865. Returning to Polk City he was married in 1867 to Miss Mary Robinson. Of their children only one—George, a student at Evanston—is now living.

In 1873 Mr. Baker moved to Des Moines, and served four years as county auditor. In 1877, with others, he organized the Baker Manufacturing Co.

IT is now generally held by electricians that the principle of the aurora borealis is the same as that shown by the Geissler tube, in which electricity is discharged through ratified air.

SCIENTIFIC MACHINIST

Formerly, WESTERN MACHINIST.

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It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain or brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

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CLEVELAND, OHIO, MAY 15, 1892.

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We have some very excellent articles, covering a wide range of subjects, in preparation for the SCIENTIFIC MACHINIST. Some of the papers announced early in the year have been slow in coming, but the Summer months' numbers will be rich in mechanical information and thought, and some new and novel features are expected to be inaugurated in the Fall.

MR. EDWIN WOODWARD'S "Hints to Engineers" have now reached the tenth paper. Those who have followed them closely will acknowledge that the series has been most instructive and valuable. Mr. Woodward has not yet finished these papers.

NEW CATALOGUES.

The catalogue recently issued by Montgomery & Co., 105 Fulton St., New York, is the most remarkable volume put in print for some time. It is a very complete catalogue of tools, containing over 700 large pages and between 3,000 and 4,000 illustrations. Any mechanic, manufacturer or jobber will be able to get more practical information of advantage to him from it than from any other book of the same size we know of. It is handsomely bound in substantial cloth, is strong and very durable, as such a work should be. There have been many callers at our office to see it, so favorable has been the report of all who have examined the copy sent us. Catalogues are very costly. Dealers carrying as large a line as Montgomery & Co. seldom endeavor to give a catalogue circulation beyond a circle of large buyers, although the value of a first-class machinery or tool catalogue has long been recognized. The novelty in regard to this catalogue is not only the completeness and remarkable practical value of it, but also the plan of its publishers to give it universal circulation—a thing we can not remember to have been done before. This immense volume is offered for sale by the publishers for $1, with express charges paid. It will cost them not less than 50 cents more than they get to place it in the hands of the purchaser, for they can scarcely manufacture the volume for $1. And this is not all. Every purchaser has the opportunity of getting the price he paid for it back easily, for any one who buys a book will have the dollar refunded him upon sending to the firm an order for $10 worth of goods or more. Every mechanic or manufacturer can thus very easily get one of these magnificent books free, for if he does not want any goods for a time, some of his friends will be glad to avail themselves of the information contained in the book, and to order from this firm. It should not be supposed that it is in any sense a book that tends to throw trade to the house that published it to the disadvantage of the buyer. Every one should have a copy, even if he does not and cannot buy of Montgomery. It is a complete list of tools of every make. By it one can see from the illustrations what there is in the market, and can order much more intelligently. When a tool is wanted one can turn to the pages containing the makes, price and other details of such tools and will learn from the information given just what will meet his wants. There is nothing like it in print for general distribution. Every one having to do with machinery or tools should jump at the chance to get two or three hundred catalogues combined in one handsomely gotten up book for $1. When a comparatively small purchase makes it come absolutely free, the inducement is irresistible. Montgomery & Co., 105 Fulton street, New York City, is the address of the publishers.

The last book catalogue from Theo. Audel & Co., 91 Liberty street, New York, is very complete. The list of mechanical and scientific books is considerably increased. It is a handy pamphlet to possess, and any one can get a copy by simply addressing the publishers and requesting one, as it is sent free. We desire specially to note one work found therein—"Maxims and Instructions for the Boiler Room." This is a work of great value to any one having charge of boilers. It is described in the catalogue. Address Theo. Audel & Co., 91 Liberty street, New York.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(366.) D. J. Crain, West Superior, Wis., writes: "Please be so kind as to inform me through 'Questions and Answers' column, what is the most scientific way of finding the dead center on a horizontal or vertical engine." *A.*—When the cross-head is 1" from the end of the stroke, tram it, also the fly-wheel. Turn the engine over center and back until the tram at the cross-head comes into center punch mark again, then mark the fly-wheel as before. Divide the distance equally between the marks on the fly-wheel, then turn the engine over until the tram comes to this mark—which is the dead centre.

(367.) J. S. DeGroff, Burlington, Kan., asks: "What is the amount of coal (Western lump) used per H. P. on a Corliss engine, and how many pounds of water are evaporated for each H. P." *A.*—From six to eight pounds of water will be required per pound of coal, and about 30 pounds of water per H. P.

(368.) Louis Adamson, Brookings, S. D., writes: 1. "I am running a 14"x42" Reynolds Corliss engine making 85 turns a minute and non-condensing. How should the valves be set to get the best result? 2. Where should the feed water be delivered in a steam boiler? 3. Can a bull-ring on a piston head be parted on one side and a key put in to expand it to the cylinder? 4. What is the size of the cylinder on a steam engine indicator? Please tell me the right size. 5. How far should the grate bars be from the boiler in a furnace, when the boiler is arched in brick, length of boiler 16 feet and 54" diameter." *A.*—1. The valves should be adjusted with an indicator, as it is the only correct way. 2. This depends on the style of boiler and setting. The feed should go into the coldest part of the boiler. 3. No bull-ring nor piston head should be expanded to fit the cylinder. The packing rings are for this purpose. 4. Exactly ½" in diameter. 5. Grates should be from 25" to 30" from the boiler.

(369.) F. W., Reese, Mich., writes: "I have a 10 H. P. threshing engine of the Stillwater make, which is in a small feed mill, and it seems impossible to keep the tubes tight. This rig, as well as others of the same make and size, has done the best of work while out threshing, but on putting it in the mill the tubes commence to leak. I then expanded them and calked them down, as I have done with many other tubes before, and made them tight. But in a short time they were leaking again. I went over this ground several times with the same result—they would soon get to leaking again. I then took out all the tubes and replaced them by entirely new ones and took pains in putting them in, but in one week they were leaking again. The water seems all right and of a soft nature. The well is on a low piece of land and after a rain the boiler will foam terribly for a few days. Could you give the reason for the trouble I have, or suggest a remedy? At times the tubes will all tighten up of their own accord, then commence leaking again." *A.*—There may be scale on the tubes and tube sheet, or you may be pumping water into the boiler or in tubes before it is sufficiently heated. If your feed enters the leg of boiler and is heated before going in, we would then suggest that you put copper ferrules on the ends of the tubes. This may, we think, overcome the difficulty. Sometimes water is supplied to a well by a stream, underground. This may be good water for the boiler, but when a heavy rain comes, percolation may bring into it chemicals from the soil that will render it very injurious. You might improve it on such occasions by putting soda in.

(370.) W. G. Bates, Pittsburgh, Pa., writes: "I would like to know what the counter-bore of a cylinder is. I have heard a good deal about it, and suppose it is proper for me to ask the question, even though I display ignorance thereby of which I should be ashamed. But I am a young engineer, and want to learn." *A.*—The counter-bore of a cylinder is the bore on each end of a cylinder from one-sixteenth to one-sixth of an inch larger than the bore between the ends. The oscillation of the piston in a cylinder wears the cylinder walls, and if the bore was even, the wear would form a shoulder. But the piston passes over the counter-bore, into the wider diameter, and the walls are thus worn down perfectly even. It is also of use in properly lining an engine.

(371.) "Inquirer," Auburn, N. Y., asks: "What is the difference between the half-moon and the crab-claw valve gear in a Corliss engine?" *A.*—The crab-claw, or old style valve is opened towards the cylinder center, obstructing the passage for supply, thus driving, or forcing the steam around the valves. This was long regarded as an objection. The half-moon valve opens in the opposite direction, or away from the center of the cylinder, leaving an unobstructed passage into the cylinder for the steam.

(372.) J. W. M., Quincy, Ill., writes: "How is the horse-power of an engine determined? If any high mathematics occur, tell me how to get through them and greatly oblige a subscriber and constant reader of your paper." *A.*—The rule is to multiply the area of the piston face in inches by the average pressure in the cylinder, and the result by the feet traveled per minute by the piston, and divide by 33,000. The only mathematics in such a problem that might bother any man of limited education would be the determining of the number of square inches in the face of a piston. To enable one who can not figure out this, to calculate the horse-power of an engine, we give below the area in inches of circles from 4 to 40 inches in diameter. We have omitted the fractions of an inch below eighths. To determine the area in inches of the piston, which is

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simply a circle, find the diameter in inches of the cylinder. This will be the diameter of the piston. Then refer to the table and find the square inches in a circle of that diameter. Each line in the table gives the square inches in a circle of the diameter indicated in the first column, and the fractions. Thus, if a piston is 10¾″ in diameter, follow the first column down to 10, then follow the line out to the column headed ¾, and figures in this place, 90.762, give number of square inches in a circle ot that diameter. Or 21″ diameter give 346.36 square inches, and 21½″ diameter give 363.05. The table is given below:

Diameter of cylinder in inches.	Area in square inches.	⅛	¼	⅜	½	⅝	¾	⅞
4	12.566	13.364	14.186	15.033	15.904	16.800	17.720	18.665
5	19.635	20.629	21.647	22.690	23.758	24.850	25.967	27.108
6	28.274	29.464	30.679	31.919	33.183	34.471	35.784	37.122
7	38.484	39.871	41.282	42.718	44.178	45.663	47.173	48.707
8	50.265	51.848	53.456	55.088	56.745	58.426	60.132	61.862
9	63.617	65.396	67.200	69.029	70.882	72.759	74.662	76.588
10	78.540	80.515	82.516	84.540	86.590	88.664	90.762	92.885
11	95.033	97.205	99.402	101.623	103.869	106.139	108.434	110.753
12	113.097	115.466	117.859	120.276	122.718	125.184	127.676	130.192
13	132.732	135.297	137.886	140.500	143.139	145.802	148.489	151.201
14	153.93	156.69	159.48	162.29	165.13	167.98	170.87	173.78
15	176.71	179.67	182.65	185.63	188.69	191.74	194.82	197.93
16	201.06	204.21	207.39	210.59	213.82	217.07	220.35	223.65
17	226.98	230.33	233.70	237.10	240.52	243.97	247.45	250.94
18	254.46	258.01	261.58	265.18	268.80	272.44	276.11	279.81
19	283.52	287.27	291.03	294.83	298.64	302.48	306.35	310.24
20	314.16	318.09	322.06	326.05	330.06	334.10	338.16	342.25
21	346.36	350.49	354.65	358.84	363.05	367.28	371.54	375.82
22	380.13	384.46	388.82	393.20	397.60	402.03	406.49	410.97
23	415.47	420.	424.55	429.13	433.73	438.36	443.01	447.69
24	452.39	457.11	461.86	466.63	471.43	476.25	481.10	485.97
25	490.87	495.79	500.74	505.71	510.70	515.72	520.76	525.83
26	530.93	536.04	541.18	546.35	551.54	556.76	562.	567.26
27	572.55	577.87	583.20	588.57	593.95	599.37	604.80	610.26
28	615.75	621.26	626.79	632.35	637.94	643.54	649.18	654.83
29	660.52	666.22	671.95	677.71	683.49	689.29	695.12	700.98
30	706.86	712.76	718.69	724.64	730.61	736.61	742.64	748.69
31	754.76	760.86	766.99	773.14	779.31	785.51	791.73	797.97
32	804.24	810.54	816.86	823.21	829.57	835.97	842.39	848.83
33	855.30	861.79	868.30	874.84	881.41	888.	894.61	901.25
34	907.92	914.61	921.32	928.06	934.82	941.60	948.41	955.25
35	962.11	968.99	975.90	992.84	989.80	996.78	1003.71	1010.81
36	1017.87	1024.95	1032.06	1039.19	1046.39	1053.52	1060.73	1067.95
37	1075 21	1082.48	1089.79	1097.11	1104.46	1111.84	1119.24	1126.66
38	1134.11	1141.59	1149.08	1156.61	1164.15	1171.73	1179.32	1186.94
39	1194.59	1202.26	1209.95	1217.67	1225.42	1233.18	1240.98	1248.79
40	1256.64	1264.50	1272.39	1280.31	1288.25	1296.21	1304.20	1312.21

(373.) C. B. C., Kentucky, writes: "I would like to ask how you would make an injector force hot water, even if the water flowed to it. Your answer to 'Virginian,' in question No. 360, in the April 15th issue, is what I can not understand." *A.*—We did not intend to say that the injector would force hot water, if it did not have to be sucked. The condition "if the temperature of the water does not exceed 150 degrees," was inadvertently left out by the compositor and not detected by the proof-reader.

There is a considerable number of questions that have not been taken up for answer. Some of these queries are not in such form as to be understood, and some are not considered of general interest. Most of them, however, are proper, and will be answered, in their turn. Readers should not be deterred from asking questions because they can not always be answered in the next issue. Send them in. They shall be given prompt attention, in their order of priority.

CLEARANCE, PORT AREA AND REHEATING.

BY LOUIS I. SEYMOUR.

One of the things in engineering whose importance seems to be greatly underrated, is the clearance volume of a steam cylinder. When designing a steam cylinder, all the preliminary calculations are made without reference to clearance, internal condensation, friction and other losses, which are all allowed for finally, but usually with a wide margin for unknown quantities. If any one who has not considered the item of clearance will carefully plot the performances of engines which in his experience have given the highest economical results, several things will be found necessary to a low steam consumption, namely, high steam pressure, small clearance, not too many expansions in any cylinder, steam jacketing, and a valve gear that will give a card as near the theoretical as possible. By a species of elimination one may then see which of the above requisites are most necessary to an economical performance.

We have heard a great deal in the last ten years of the valve of high piston speed, but by the above process of reasoning its value will be seen to be by no means great—in fact, the lowest of any of the class. One good illustration is worth a lot of theory in such matters, so I will refer your readers to the performance of the compound beam pumping engine at the Lawrence water works in Massachusetts. The cylinders are 18″ and 38″ diameter by 8 feet stroke, with very short ports, gridiron valves operated by cams, automatic cut-off in the high pressure cylinder, and no cut-off at all in the low pressure cylinder. Both cylinders steam jacketed. The clearance for the high pressure cylinder averages .024 per cent., and for the low .017 per cent., so that the real effect ot high pressure clearance when referred to the low pressure volume was only about .007. This engine consumed only 14.2 pounds of feed water per indicated horse-power per hour, using steam of only 90 pounds pressure, and with the piston speed of only 265 feet per minute. The total expansions in both cylinders were only about 14½. The triple compound Reynolds-Corliss engines at Chicago, with high pressure clearance 1.36 per cent., intermediate 1.45 per cent. and low pressure 2.51 per cent. with a steam pressure of only 127 pounds, and a piston speed of only 167 feet per minute, give an indicated horse-power on only 12.675 pounds of feed water per hour, when working with only 24 expansions, or less than three expansions per cylinder average. Both these engines were thoroughly steam jacketed, were tested by reliable experts, and both arrangements of valve gear were among the best to be found.

While these tests do not show that high piston speed has no effect, they do show that its value can be ignored without perceptible detriment to the result. Another more convincing argument is the fact that while we get results from slow speed engines frequently, in our technical papers, we never hear of any worth recording from the high speed tin-pot class so much affected of late years for electric lighting and kindred purposes. The Sulzer, so extensively used in Europe, has the valves arranged as close to the cylinder as possible, reducing the clearance to about 2½ per cent. and gives at piston speed of about 450 feet per minute, a duty of one indicated horse-power on 14.5 pounds of steam.

Instances can be multiplied indefinitely to confirm this theory. Insufficient port area is at the bottom of many poor performances, especially in compound engines. This is particularly true of the high pressure exhaust, where it sometimes occurs that the power required to push the steam out of that cylinder more than counterbalances any gain from compounding. I have before me some cards taken from a pair of winding engines of the most approved type, with double beat valves, but having a port area of only 4 per cent. This engine at certain parts of the run develops the astonishing piston speed of over 1,000 feet per minute, when the back pressure amounts to no less than 23 pounds per square inch, the mean effective pressure being 26 pounds. I leave your readers to imagine the annihilation of coal that takes place at that plant, at the rate of $44 per ton (at Kimberly, South Africa). If these cylinders had been exhausting into the receiver of a compound instead of the atmosphere, the results would have been very poor, and compounding would have received a black eye, whereas the fault lies in too small port area.

Now that multiple cylinder engines are so universally used, the danger is that compounding may be carried too excess. Let us start with steam at 150 pounds pressure absolute. The temperature will be 358° when entering the cylinder, and if exhausted into a good condenser, will be about 150° or a difference in one cylinder of 208° every revolution. By compounding we reduce the range of temperature in each cylinder to 104°; by tripling, to 69°; and by quadrupling, to 52°; the difference between tripling and quadrupling being only 17° per cylinder, while between the simple and the compound the difference is 104°, or six times as much. Taking into account the extra friction, it seems doubtful that the fourth cylinder can be of any use at pressures that any reasonable man would adopt. In most cases a superheat of 40° or 50° would do more good than the adoption of another cylinder. Now that thermostats are so easily obtained, a superheater might easily be arranged in a supplementary flue, with a damper so arranged that for a certain rise of temperature the flue gases would be diverted direct to the chimney, the damper regulator acting on increase or decrease of temperature instead of pressure. The only drawback to superheating seems to be that so far no one has taken sufficient precautions to prevent too much of it at times when the steam outlet is temporarily closed. Almost any boiler will give good results when giving off a small quantity of steam, but nearly all of them prime more or less when evaporating at their rated capacity, so that the main office of the superheater would be to evaporate the moisture present in the steam and make it into a dry gas, as the loss from using steam in a wet condition is the main cause of the uneconomical performance of many plants otherwise well equipped. I have a case in hand just now where a pair of engines driving a mechanical haulage about three miles long, supplied with steam from a locomotive type boiler, cylinders non-jacketed, slide valves with the rider cut-off, but owing to the wet steam supplied by the boiler, the consumption of steam per indicated horse-power per hour is slightly over 40 pounds. As soon as we get the superheater in I shall expect a drop at once of one-quarter this amount.

By lagging the pulleys of overworked belts you can prevent much of the slip.—[Power.

A Reply to "J. J. H."

In the issue of the SCIENTIFIC MACHINIST for May 1st, "J. J. H., of Akron, O." expresses the hope that the writer will not "make his articles too high up for the greasy engineer who has not gone through Cornell University, to understand."

It certainly seems that what one "greasy engineer" writes, another should understand, especially when the writer's education was limited to the county district school.

If "J. J. H." will read the last portion of "Erecting Steam Plants—III," he will see that rules were printed out in plain English, for performing the various operations, and then other rules were given in the shape of various formula for doing the same thing, so that the reader can use either method as he chooses. The beginner may take the plain English, or he may add to his knowledge by studying out the algebra.

There is no reason why an engineer should be frightened the first time he sees x, y and z. If a man was doing a hard piece of work, he would not be alarmed if somebody should come along and show him a shorter, easier, and better way. Indeed, he would adopt the improvement at once, and even spend considerable time and trouble to understand the labor saving way, but just as soon as the short cut of algebra is offered to the mechanic for use in making easy laborious calculations, just then will he leave his hammer and wrench hanging in the air, and call a halt.

It would be better, if a man would, when coming across a line or two of algebra, stop and read it once or twice, and see if it be not a short cut across-lots, instead of a mountain "too high" to be climbed.

The engineer who is hoping to "get to the top" in his profession, will learn that life is too short to get there without the use of algebra in his calculations, that man has ceased to be afraid of it, and he has found that algebra is like a singed cat, *i. e.*, much better than it looks.

JAMES F. HOBART, East Pepperell, Mass.

Electrical

Electrical Lessons for Machinists and Engineers.

[There has been such a demand for the production of "Electrical Lessons" in compact form that we reprint them in two parts. We expected to publish them in pamphlet form, but considered this the better.—ED.]

The first question invariably asked by a student is: "*What is electricity?*" To this no more satisfactory answer can be given than to the questions, what is heat, light, gravity, etc.?

If electricity, light and heat are not the same, they are very closely related. The question with us should be not what is electricity, but how best to apply it.

As we know how to obtain and apply artificial light and heat, so also do we know in a measure how to obtain and apply artificially produced electricity.

The simplest and most direct way to generate electricity is by means of the voltaic cell or battery, but the method of generating electricity to operate devices coming more within the range of our lessons is by the dynamo machine.

A voltaic cell consists of two metallic plates of different metals, submerged in a solution which will very readily and rapidly attack one plate without affecting the other.

By connecting a wire to each of these electrodes and attaching the free ends of the wires to a galvanometer, the indicating needle thereof will instantly be deflected and show that a current of electricity is passing through it.

A *voltaic cell* is, then, an appliance for artificially producing electric energy from chemical action. The metal plates of the battery are called the *electrodes*, the one attacked being the *positive* and the one not attacked the *negative*.

The battery solution or exciting fluid is called the *electrolyte*. For powerful currents such as are required for light and power, the solution is composed of some of the acids diluted more or less with water. When the wires from the cell are joined together, through the galvanometer, it is said that the *circuit* is complete or closed, *i. e.*, that there is no break in the chain of conductors.

The *circuit* is said to be open when the chain is severed at any point throughout its entire length. Simply connecting together the battery wires without the galvanometer or other device in *circuit* would be called *short circuiting the battery*. The effect of such short circuiting would result in a rapid destruction of the battery.

By the *opening* and *closing* of the electrical circuit by means of a suitable lever called a *key*, the telegraph operator transmits his messages. A short depression of this key will indicate at the distant end of the telegraph line a *dot*, while a longer depression will indicate a *dash*; these dots and dashes are grouped together to represent the alphabet.

The galvanometer is an instrument for indicating the presence of electricity. It is to the electrician what the mariner's compass is to the sailor. The galvanometer, like most other electrical instruments, is exceedingly simple. It consists essentially of a freely suspended or pivoted *magnetic needle* around which is wound a number of convolutions of fine *insulated* wire. The deflection of the needle, with the same power, may be increased by increasing the number of convolutions of wire. Instruction for making a simple form of galvanometer will be given when the subject is reached.

The galvanometer is simply an instrument employed to show the presence of an electric current, or to show when electricity is passing through the circuit of which it forms a part.

The circuit is the path over which the current flows. The ordinary galvanometers are graduated simply in degrees, which by themselves have no actual value. The galvanometer in all its various forms consists of a coil of *insulated* wire having a magnetic needle freely pivoted or supported within, and so that when a current passes through the wire it will have the greatest effect upon the needle. The best results are obtained when the coil and magnet are close, and when each convolution of the coil lies in a plane perpendicular to the needle.

The magnets of the class of galvanometers called *Detectors*, are pivoted in a vertical plane having one end made slightly heavier than the other, so that it hangs with the pointer perpendicular. A current passing through the hollow coil will cause the needle to be deflected to the right or left, according to the direction of its flow.

The principle of construction of the galvanometer may be understood better by reference to Fig. 1, in which N S represents the freely pivoted needle, and A B C the connectors to an insulated wire which surrounds it. When the two wires from a battery are connected to A and B the current will flow only through the upper wire and the magnetic needle will be deflected only slightly. On removing the battery wire from A and connecting it with B, and the other battery wire from B and connecting it with C, the current will flow through the lower wire only, and under like conditions the action on the needle will be the same, so that when the current passes in the same direction the action is the same through the upper or lower wire. On removing the battery wire from B and connecting it with C, the deflection of the needle will be considerably increased, as the wire below will exert a like influence on the needle and in the same direction as the wire above, and the deflection of the needle will thereby be increased; and so on, will the deflection of the needle be increased for each and every additional turn of the wire forming the hollow coil which surrounds it.

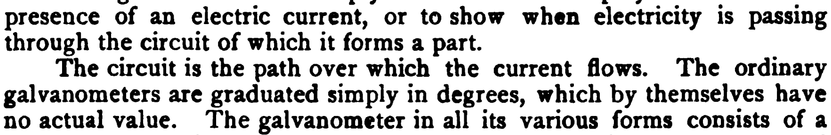


FIG. 1.

By connecting one battery wire to both A and C, and the other battery wire to B, we will, so long as the wire above and below the needle are equal, obtain no deflection. The reason for this is that the current is divided equally between the two wires and the influence of one wire on the needle is counteracted by the influence of the other, which is reversed. Galvanometers constructed on this principle are called differential. By increasing, decreasing, or in any way altering the resistence of one of the wires only, we again get a deflection. This fact is taken advantage of and will be fully explained when dealing with the construction of the apparatus for testing.

The needle tends, at all times, on the passage of the electric current through the wire, to set itself at right angles to the wire, and this it does in proportion to the number of turns of the wire and the strength of the current.

If we reverse the position of the battery wires by connecting the one removed from A to C and the one removed from C to A, we shall also reverse the direction of the deflection of the needle, and this action will be due to the change made in the direction of the passage of the current.

The current, in passing through the hollow coil of the wire, produces in the space surrounding it a *magnetic field*. It is this temporary magnetic field which acts upon the *permanently* magnetic needle and causes it to be deflected.

From the above you have learned that a current passing through a fixed wire which is supported parallel to a magnetic needle, will cause the needle to be deflected or to take up a position at right angles thereto, in proportion to the strength of the current flowing, and that by increasing the number of wires or convolutions of the insulated wire around a freely pivoted magnetic needle, it will, with the same current, likewise increase the deflection of the needle.

We have learned also that the electric current, as it flows through the insulated wire, causes each turn, half turn or complete convolution, to act for the time being as though it were itself a magnet, and that the space around the wire thus influenced is called the magnetic field. Further, that when a freely suspended magnetic needle is at rest it will have its ends directed to the North and South pole of the globe, and that when thus influenced it is said that the action is due to the earth's magnetism.

In all horizontal forms of galvanometers, before the current is allowed to pass for taking a reading, it is necessary to place the instrument so that the needle comes to rest at zero under the influence of the earth's magnetism. The deflection of the needle caused by the passage of the current will then determine its strength.

The word *poles* is, in general, applied to the ends of magnets, to the ends of batteries, to the terminals or ends of the armatures on dynamo machines, electric motors, etc.

It is a fact no doubt well known to all our readers that one *pole* of a magnet will repel the like *pole* of another magnet, and that unlike poles will attract each other; and that the expression *poles* is generally understood as meaning the ends of magnets, batteries, etc.

The poles of an artificial magnet are generally designed to be at their ends, but they are always a little distance therefrom. They are distinguished one from the other by calling one the South and the other the North pole. The poles of a battery, as before stated, are its ends. The terminating plates or electrodes in a battery composed of a number of voltaic cells are distinguished one from the other by calling one the *negative*, the other the *positive* pole.

The negative terminating plate or electrode is the positive pole, while the positive terminating plate or electrode is the negative pole of a battery. The above should be very firmly impressed on the memory, as this apparent contradiction is a common source of trouble.

Speaking generally, we may say that the *volt-meter* and the *ampere-meter* are simply galvanometers which have their coils especially wound and their dial faces carefully graduated and marked, so that the volts or amperes in a circuit of which they are a part, can be read directly as the weight on a pair of scales or as the pressure on a steam gauge.

A *volt* is the *unit of electro-motive force*, and it is symbolized by E. It is equivalent to the difference of potential between two points, or it is that force which will maintain a circuit of one ampere in a wire having a resistance of one ohm.

The volt-meter is, then, an instrument for measuring the electro-motive force or the E M F as usually written, which is expressed in *volts*.

The E M F is the force which moves electricity. It is sometimes called electric pressure, difference of potential, electric force and potential. The only difference between electro-motive force and potential is that the former relates to the *conductive* while the latter relates to the *inductive* circuits. The electro-motive force expresses to the electrician what steam in a boiler does to the engineer.

The *ohm* is the *unit of resistance* and is symbolized by R. One ohm is the resistance through which one ampere of current will flow when driven by a pressure of one volt of E M F.

Electrical resistance is the opposing force to electro-motive force: Resistance to electricity exists more or less in every electrical circuit, just as resistance exists in water pipes to the flow of water through them. The metals are the best conductors of electricity because they offer, compared with other materials, less resistance to the passage of the current. A good conductor renders the same sort of service to the electrician as the large water pipes do to the engineer.

The greater the E M F in proportion to the resistance of a circuit the greater will be the strength of the current, and vica versa. The greater the resistance of a circuit the less will be the current strength. Thus by doubling a given conductor, the strength of the current will be doubled.

The *ampere* is the *unit of current* per second. It is symbolized in formula by C and is that quantity of electricity which flows per second through a resistance of one ohm, at a pressure of one volt of electro motive force. The ampere-meter, is then, an instrument employed for measuring this current strength, or the intensity of the current in amperes.

The current strength is always directly proportional to the electro-motive force. It becomes proportionally less as the resistance of the circuit becomes greater. When an electro-motive force of one volt drives a current through a resistance of one ohm, that current is said to have an intensity of one ampere.

The fact that electro-motive force and resistance bear a relation one to the other was discovered by "Ohm," who propounded the law of electricity in motion, which now guides the electrician in his calculation. Knowing the current strength and the rate at which the E M F puts it in action, we can readily find the work done, as by multiplying the volts and the amperes we obtain the energy in watts.

The *watt* is the unit of energy or power and is equal to about $\frac{1}{746}$ of a mechanical horse-power. With a constant resistance the current is proportional to the electro-motive force with the same difference of potential and it is halved by doubling the resistance. In other words, if we, with a given potential, get an unit of current over a wire one mile long, we get but half this unit of current over the same conductor when it is increased in length to two miles.

Ohm's law expresses the above thus: "C," current strength, "E," electro-motive force; "R," resistance.

$$C = \frac{E}{R} \text{ or } E = C \times R$$

The current in amperes may be found by dividing the E M F in volts by the resistance in ohms.

To find the electro-motive force in volts of a circuit, it is simply necessary to multiply the current in amperes by the resistance in ohms. The resistance of a circuit may be found by dividing the electro-motive force in volts by the current in amperes.

The *colombe* is the *unit of quantity* and it is symbolized by Q. It is that quantity of electricity which is given by one ampere in one second.

The next most important effect for us to study is the action of the electric current on a bar of soft iron enclosed within a coil of insulated wire in place of the permanently magnetized steel needle we have been dealing with.

Such an arrangement is called an *electro magnet*. The soft iron is called the *core*, and the coil of insulated wire surrounding it the *helix*.

A current of electricity passed through the helix will act upon the soft iron core within as it did upon the permanently magnetized needle of the galvanometer. In this instance, however, the iron cores are converted into a powerful electro magnet, one free end of which is said to have North and the other free end South polarity.

The nearer the coils of wire forming the helix are to the soft iron core the greater will be the magnetic effect in the iron when the circuit is completed. A piece of Norway or Swedish iron placed with a coil of wire will, when a current is passed through the coil, become magnetized in proportion to the number of turns of wire around the iron, in proportion to the strength of the current passing through the coils, and in proportion to the distance between the coils of wire forming the helix and the core.

If we place a bar of soft iron in a helix of insulated wire, the ends of which are connected in circuit with a voltaic battery and a key for opening and closing the circuit, we may energize this core at will by simply depressing the key so as to close the circuit. This is the principle of the electric bell and the Morse and other telegraphic instruments. It will readily be understood that the closing of the circuit by depressing the key will act upon the iron core so as to make it a magnet, but only for the time during which the circuit remains closed. On arresting the flow of the current by releasing the key, the magnetic effect in the iron core is also arrested.

The softest iron and the best should alone be selected for the cores of electro magnets, for the reason that good, soft iron immediately parts with its magnetism when the influence of the current is removed by opening the circuit. Whereas hard iron or steel will retain magnetism in proportion to their hardness and consequently will respond to the action of the current proportionately slower.

The quality of the iron for the cores, armatures or field magnets of electrical machines is one of the most important points to be considered in their construction.

Of course work is done in energizing this piece of iron so as to make it an electro-magnet capable of sustaining a considerable weight.

It may be a question with some as to what the source of this energy is. When the current from a battery is employed the energy to do the work is so far primarily due to the chemical energy in the cells which on being converted into electric energy, act upon the iron so as to cause it to develop energy in the form of magnetism.

When a steam engine is used to drive a dynamo machine to generate electricity the coal burned is so far the source of energy.

It should be remembered that in every transportation of one form of energy into another there is a very considerable loss, therefore the more direct the means of producing and utilizing the current the less will be the loss. A great part of the energy expended in producing the electric-magnetic energy in the soft iron, will, if the core be removed, be expended in heating the wire. The chemical energy of the battery will likewise be expanded in producing heat energy in the wire of an helix.

This heating effect will be dealt with presently as fully as space will permit. The heating effect is proportionately less as other work done by the current is proportionately greater.

We have stated that the effect of temporarily closing the electric circuit through the helix is to temporarily magnetize the soft iron core. We may say that the effect of closing a voltaic battery circuit through an electro-magnet is to convert the chemical action developed in the battery into magnetic energy developed in the soft iron core of the electro-magnet. If the core is removed from the helix the same amount of work is still done, but it shows itself in a different way. In this instance the chemical energy developed in the battery would appear in the helix and connecting wire as heat energy.

Iron is the only metal which can be practically employed for electro-magnets, although nickel is acted on in like manner by the current, but in a much slighter degree and at much greater cost. The object of insulating the wire of the helix is to compel the current to travel from one end of the wire to the other.

If the wire actually touched, *i. e.*, made metallic contact at any two points between the ends, the greater part of the current would pass at the point of contact instead of passing around the convolution of the loop, which would be intermediate in the wire and between the points of contact.

Thus you will understand the necessity for perfect insulation in electric wires.

The current will at all times take the path of least resistance, and rather than go round the coils it will jump across if the insulation is not sufficiently good.

Fig. 1 represents a straight electro-magnet. This, if bent at its centre so that is poles approached each other, would then be called a horse-shoe. The horse-shoe form of electro magnet is considered the best, and in this form it is used in the principal electrical devices.

Iron then is employed because in a remarkable degree it has the property of acquiring and losing magnetism very rapidly.

We have learned that an electro-magnet immediately acquires magnetism when a current of electricity is passed through the wire encircling the core, and that immediately on the cessation of the flow of electricity it almost as readily loses its magnetism. It will readily be understood from Fig. 1 that the closing of the circuit by depressing the key K will allow the current to flow through the wire around the core and make it a magnet, but only for the time during which the key is depressed and the circuit remain closed. On arresting the flow of the current by releasing the key, the magnetic effect in the iron core is at the same instant also arrested. The softest and the best iron only should be used for the purpose for the reason that cores of electro-magnets composed of good, soft iron retain but little magnetism when the influence of the current is removed by opening the circuit, whereas, if made of cast or an inferior quality of iron the magnetism is retained, and the action is sluggish.

Fig. 2

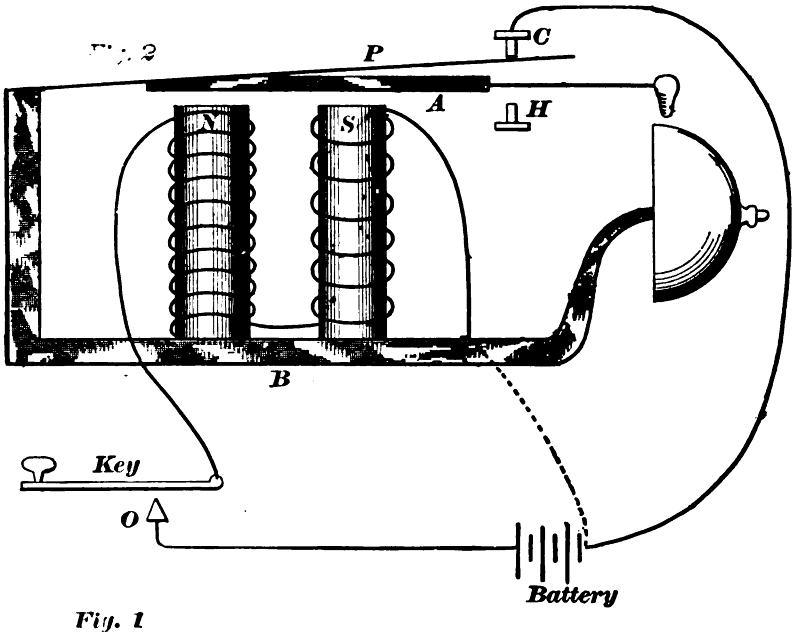


Fig. 1

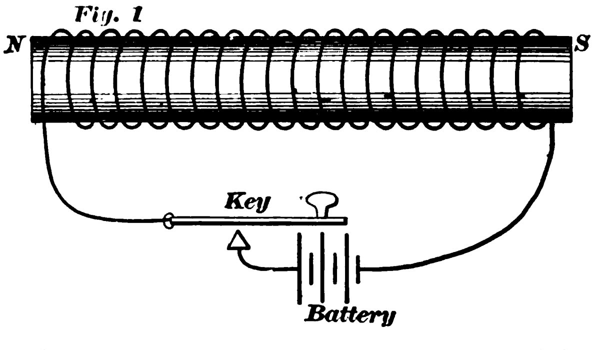


Fig. 2 diagramatically represent an electro-magnet of a form very generally employed for telegraph instruments, electric bells, etc. N and S are simply pieces of round Norway iron screwed by means of an iron screw, or riveted with an iron rivet to the plate B.

It is of the utmost importance that the cores of iron make large surface and solid contact with the iron yoke piece B.

C is a simple spring contact key for temporarily closing the electrical circuit when depressed, normally it leaves the circuit open. By depressing the key until it comes in contact with the anvil O, the current will flow from the battery through the key, out by the anvil O, through the helix surrounding N S, to the metal frame along which it travels to the armature A, out by the spring to S and back to the battery at the opposite pole to that from which it entered. The effect of the depression of the key is then to magnetize N S, which attracts the soft iron armature A until the ball at its free end strikes the gong. The instant the hammer strikes the gong the spring will be drawn out of contact with the screw C, and the circuit will be again open for an instant and until the spring and screw C come again in contact. N S will lose their magnetism on the opening of the circuit, and the armature will instantly be carried back by the tension of the spring, and the current will again be established and so on, causing the armature to vibrate and the hammer to strike the gong at each vibration. This is the principle upon which all vibrating bells are constructed.

There is very little difference between the action, etc., of an electric bell and the *Morse* telegraph instruments. If, for instance, we remove the long spring P from the bell armature A, so that the armature plays between the studs C and H, and if we also remove the wire from C and connect it with the end of the helix on S, we then have a simple Morse telegraph instrument, which may be read by the sound of the armature beating against the studs.

If we substitute a stylus for the hammer at end of armature and cause a ribbon of paper to travel above, but within striking distance thereof, we then have a Morse recording telegraph instrument.

We have already stated that dynamo machines are divided into two classes, viz.: *alternating* current machines which, as their name implies, supply only alternating currents, and *direct* current machines, which generate a current always flowing in one direction. Each machine can use either permanent or electro-magnetic fields.

By the difference of the winding and arrangement of the wires, these two classes, *i. e.*, alternating and direct current machines, are again, to meet special requirements, divided into what are termed *series* and *shunt* wound machines and different combinations thereof.

The series machines give a constant current with a varying electromotive force, while the shunt wound machines give a varying current and a constant electro-motive force, one being the opposite to the other.

Then, again, there are self-exciting and separately-excited machines. In the self-exciting machines, which may be either shunt or series wound, sufficient magnetism is always retained in the field magnets to feebly act from the start on the armature, which, as its speed of rotation is increased, cuts more *lines of force*, and in proportion thereto, generates a stronger current, which, passing through the field magnet coils in the proper direction, increases the strength of the field magnets, which again in turn so influences or acts upon the armature that it gives out a proportionately increased amount of electric energy. The self-exciting machine would appear to be an electric accummulator. A separately-excited machine is used with alternating current machines unless the latter have a permanently magnetized field.

The exciter is generally a small dynamo, or it may be a voltaic battery, placed in circuit with the field magnets only; its office being to magnetize the field to *saturation*. The commutator on an alternating generator, or machine, is required to convert the alternating impulses into a direct flowing current. Such conversion is sometimes necessary, but whenever resorted to it is attended at all times with a considerable loss of energy.

The alternating machines are more simple in construction and have the advantage of furnishing a higher E. M. F. at less cost than a direct current dynamo machine. They can also be advantageously employed for supplying incandescent lamps, especially on long circuits. For supplying arc electric lights, the direct current machines are best, as they are more simple to manipulate. They can be used for both arc and incandescent lamps, driving motors or electro-plating, etc., whereas, to do more than to light incandescent lamps the alternating machines have to be furnished with special appliances which increase the cost and the complications.

Fig. 1.

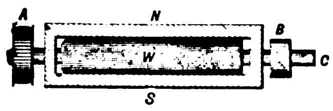


Fig. 2.

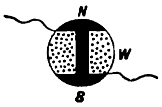


Fig. 3.

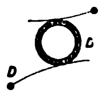
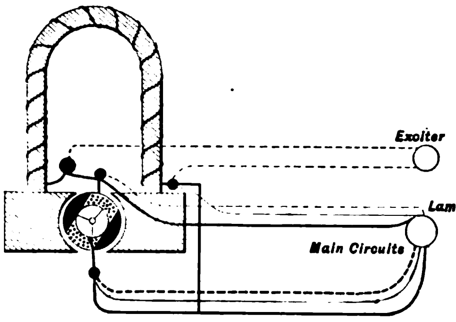


Fig. 4.



We would recommend our readers, whose intention it is to build a dynamo machine for his own use, to build it on the Siemens pattern as this is a simple machine to construct and will, to the amateur, give greater satisfaction than any other.

We may have something more to say regarding the converters and the special apparatus above alluded to. Although the forms of field magnets may differ so much in outward form, the same principles underlie all, as the object of the manufacturer is to construct a machine which will concentrate the greatest number of lines of force on each successive coil of the armature.

The different designs of armatures, although not so numerous as the different designs of field magnets, are far too numerous for us to attempt to describe here. We will, therefore, confine ourselves to two or three of the most simple and generally approved types, commencing with the Siemens and the Gramme, which are among the oldest. It would be safe to say that nine-tenths of all the dynamos on the market are simply modifications of one or the other of these.

Fig. 1 shows a longitudinal view of the Siemens armature, N S representing the poles, W the wire, A the driving wheel, B the commutator, and C the shaft.

Fig. 2 represents a cross section of the armature, and Fig. 3 a cross section of the commutator, with the brushes D D resting thereon.

Fig. 4 shows a Siemens armature revolving between the poles of the field magnets. The thin lines represent the circuit or path the current traverses to make it a series-shunt or separately-excited machine. The heavy lines show the complete circuit and winding of the shunt system, and the dotted lines show the circuit of separately-excited field magnets, with winding and circuit complete.

(Concluded in next issue.)

AN IMPROVED AUTOMATIC ENGINE.

(Continued from first page.)

details being shown in the sectional views following. This engine is unusually well balanced, the centrifugal action of the connecting rods and other parts is balanced by counter weights in the crank disks, and compression is so adjusted as to balance the momentum and overcome the inertia of piston and cross-head at the end of the stroke.

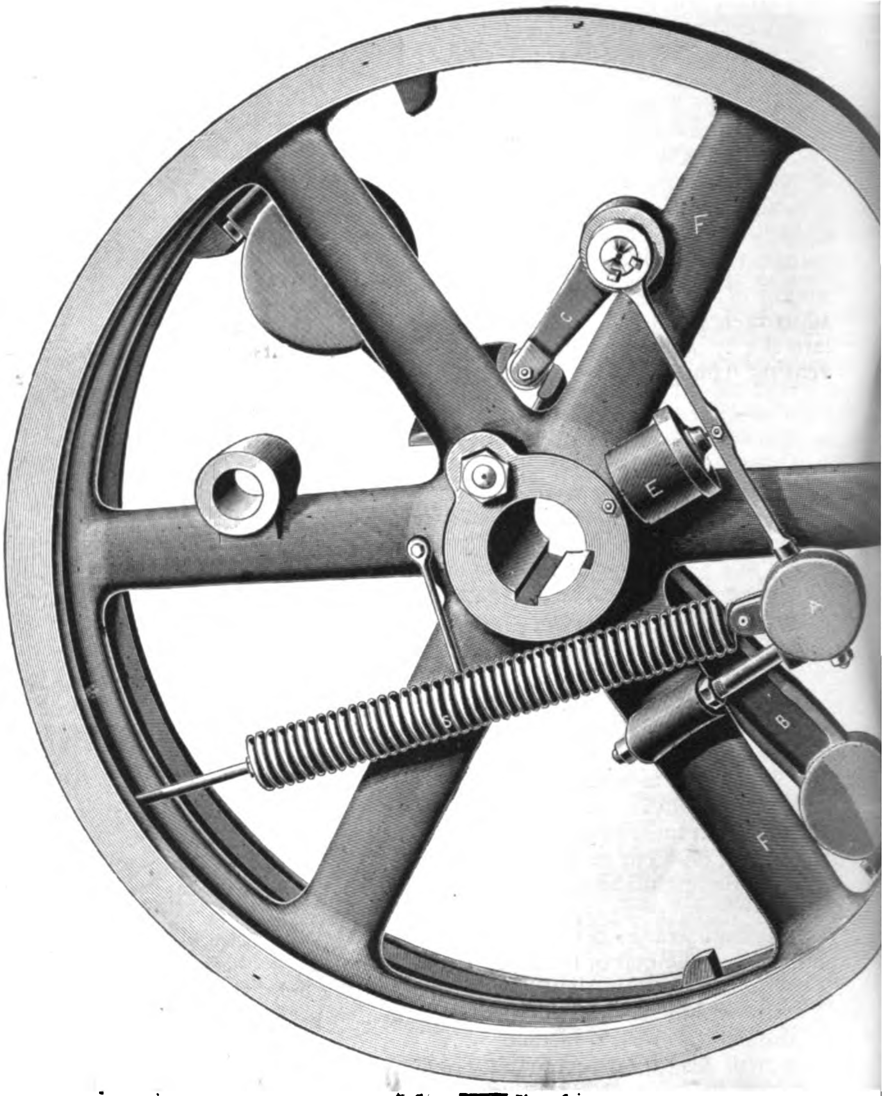


Fig. 6.

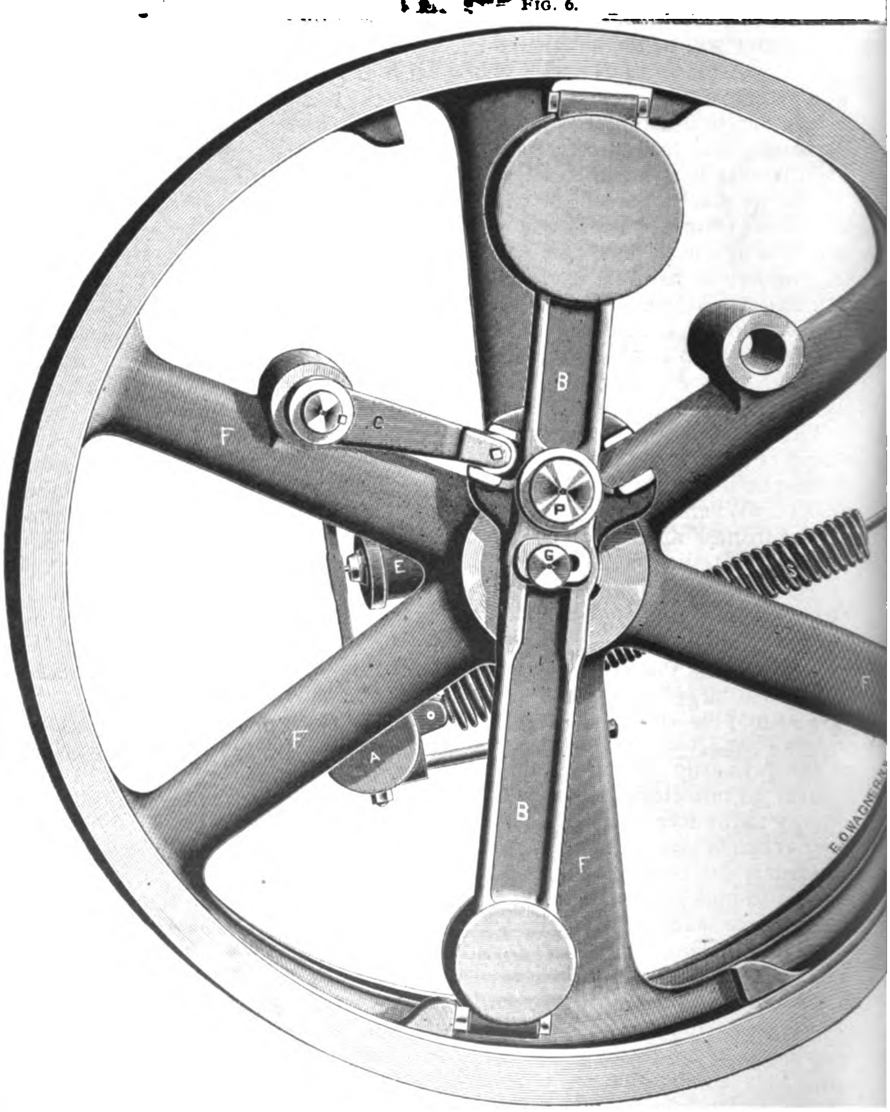


Fig. 7.

The engine is enclosed in the framework and by a cover over the crank disks so that the throwing of oil is prevented, while at the same time ample provision is made for lubrication of all moving parts requiring it, some of the parts in the governing apparatus being provided with roller pin bearings which require no lubrication.

The valve of the engine, shown in Fig. 3, with an end view in Fig. 4, is of similar type to that long used by builders of high-grade engines, but which has heretofore always been subject to more or less wear, and consequent leakage, the causes of which have been carefully determined and mostly eliminated in this construction. The improved balance plate, shown in the cuts representing sections of valve, balance plate and valve seat, shows that the port opening in the balance plate has the same dimensions as the opening on the opposite sides leading directly to the cylinder, thus giving free access to the steam, and at the same time reducing the friction to an imperceptible amount. The balance plate is so arranged and adjusted as to prevent pressure on the valve seat, excepting that due to the weight of the valve itself, which is of no particular consequence, and the adjustment of the balance plate is such that in case water should be carried into the cylinder the plate will yield, permitting its easy escape, thus preventing damage. The workmanship on the valve, as well as on all other parts of the engine, is first-class in every respect, being the best that skilled workmen can produce.

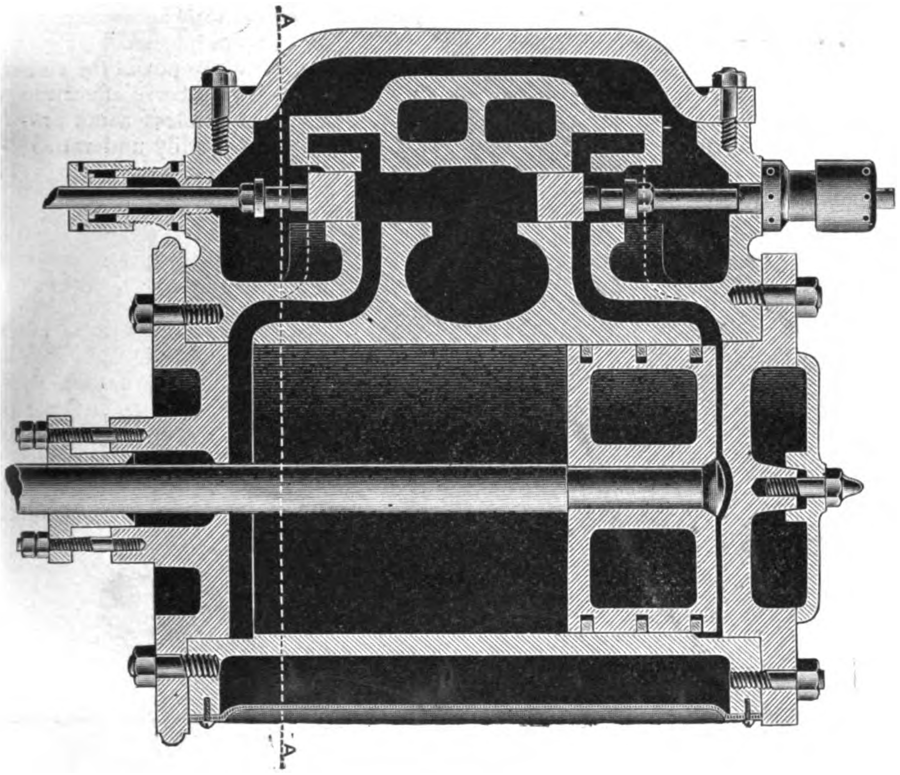


FIG. 3.

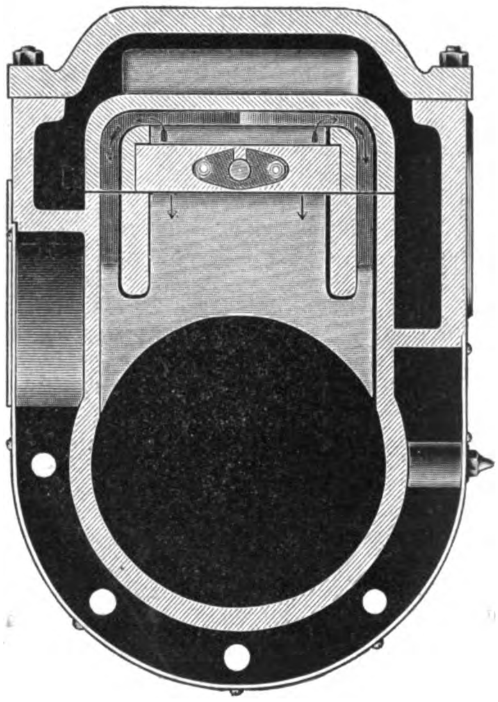


FIG. 4.

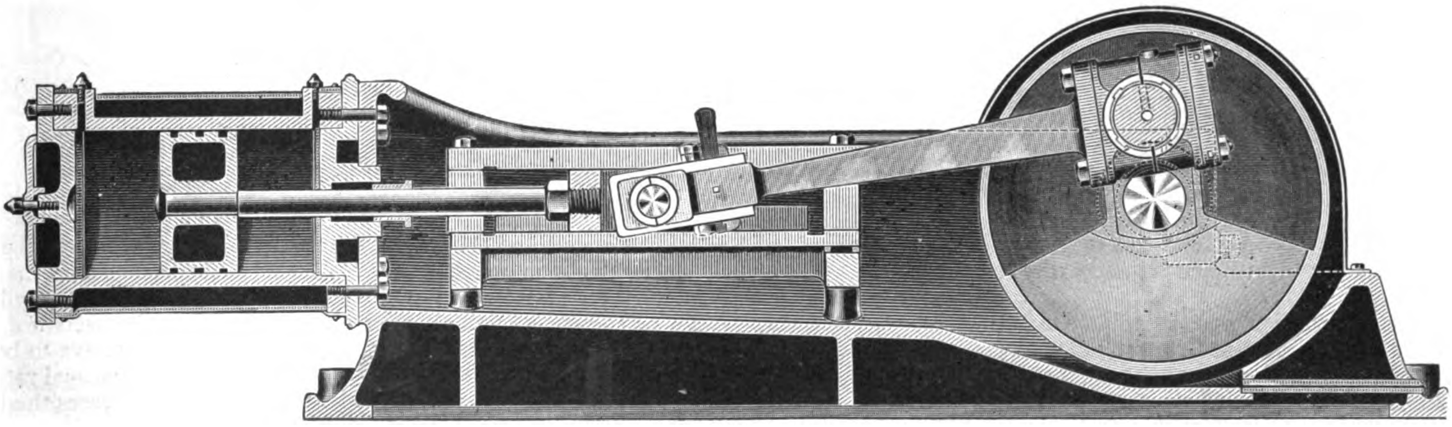


FIG. 5.

Ths piston is of the solid type made hollow and wide, giving plenty of wearing surface. The packing rings are of cast iron made eccentric and somewhat larger than the bore of the cylinder, and are sprung in the grooves of the piston, their elasticity keeping them pressed outward, maintaining a steam-tight joint and their eccentricity providing for the wear which takes place. This makes one of the best packing rings in use. The piston is forced on to the piston rod by hydraulic pressure and the rod is then riveted, which makes a joint secure against disarrangement. The opposite end of the piston rod is threaded and screwed into the end of the cross head, and fastened with a jam nut in the usual way. The cross head is of cast steel and has large flat bearing surfaces, its length being equal to the stroke of the engine. The wrist pin is of steel, accurately fitted and forced in by hydraulic pressure.

The sectional view of the engine, Fig. 5, shows very clearly the construction of the piston, the way it is fastened to the rod, the connection to the cross head and the jacketing of the cylinder and head. The connecting rod and crank pin box is also shown in this cut; the boxes are of cast iron lined with genuine babbitt metal and provided for adjustment by being drawn up against thin strips of heavy calendered paper which permit of very delicate adjustment. The main bearing is of ample length and lined with babbitt metal, and the means employed for its adjustment are similar to that of the crank pin box. The crank shaft is made of one solid piece of forged steel. The counterbalance disks are of cast iron fastened to the steel crank by keys, and are afterwards turned up true and highly polished.

The governor, shown in Figs. 6 and 7, is a radical departure and very simple in its construction. It is well adapted to keep the engine running at uniform speed under all conditions of load and steam pressure; it is sensitive to small variations in load, and its actions under greater variation is quick. Its construction can be readily understood from the cuts where it is shown that the bar B, having balancing weights at each end, is pivoted on the hub of the wheel at P, and the eccentric or valve rod is connected at the pin G, which is made adjustable in the slot, as shown. A glance at the cut showing the other side of the governor will give a clear idea of the mechanism and its operation. The lever C, which is pivoted to one arm of the fly wheel by a short shaft that projects through the sleeve is connected, on the opposite side, with the lever carrying the weight A, this being held near the center by the heavy spiral spring shown.

Connected at the center of the lever carrying the weight A is a dashpot E, which provides for the more gradual movements of the weight A when sudden changes in the load on the engine are made. The weight A acting by centrifugal force against the spiral spring, moves outward, and the movement is communicated to the lever C, the roller bearing at the end of which fits between the jaws of the casting shown, causes the lever B to move, thus varying the eccentricity of the pin G, from the center of the shaft, and changing the amount of travel of the valve, thus regulating the point of cut off in accordance with the load and maintaining the speed steadily at a given number of revolutions.

The simplicity and efficiency of this regulator are such that the greatest steadiness of speed is obtained, the engine running at exactly the same speed under all conditions of load and steam pressure, providing there is pressure enough to do the work. It will be noticed from a careful examination of the governor that it embodies a principle but little known or understood, as the controlling forces are inertia and centrifugal force; the heavy weight D acting by inertia only and weight A by centrifugal force only.

When a change of load takes place, causing acceleration or retardation of speed of fly-wheel, the inertia weight will continue at the same speed it had before the change of load took place, and the least change of position of inertia weight with reference to fly-wheel, will cause the eccentric (which is rigidly connected to inertia weight) to travel across the shaft, giving greater or less port opening as the case may be. As soon as the position of the eccentric has been changed sufficiently to admit the required amount of steam to maintain the speed, the inertia weight will come to rest acting against the movement of the fly weight A, and will therefore bring it to rest before it has moved too far in either direction. It is therefore a very stable governor; that is it will not race, and equilibrium is always promptly restored in the shortest possible time.

This engine is especially suited for driving electric light machinery, as

(Continued on page 12.)

SELECTING AN ELECTRIC PLANT.

BY FRED HERBERT COLVIN.

When it comes to selecting a dynamo, and in fact the whole electric plant for the factory, there are many things to be taken into consideration. The size of the plant, the distance the current must be transmitted from the dynamo to the lamps, the kind of lamps desired, whether arc or incandescent and whether a high or low potential is desired.

As in the question of selecting an engine, the writer would by all means advise a slow speed dynamo, if the size of the machine is large enough to warrant it. For, as in the case of the engine, a slow speed means cooler bearings, less attention to order to prevent heating, fewer repairs and fewer chances of a breakdown, which always comes when the lights are wanted on a particular job.

See that the bearings are of ample size and well constructed, that the shaft is heavy enough to prevent springing, which usually means hot bearings, that the facilities for lubrication of the machine are of the best and that the mechanical as well as the electrical details are well considered.

In the early days of electric lighting, and in fact all electrical work, the usual laws of mechanism were in many cases ignored, and machines were built and run, which in mechanical design were fit for some museum of mechanical freaks.

It used to be thought that as the machine was electrical, the mechanical construction is immaterial. This is the main cause for so many failures in the earlier plants that were installed. If the factory is only a small one, employing 40 to 50 hands, and is concentrated in one building, as is usually the case, you will want to use the direct incandescent system, unless the work is of such a nature as to make the large central light desirable. In this case a few arc lamps distributed as necessity demands will fill the bill.

In cotton and many other weaving mills these arc lamps are preferred, and they can be arranged to distribute the light very evenly and satisfactory. For mills handling inflammable goods they must be thoroughly protected so as not to cause fire by sparks.

But for work such as bench or lathe work, where it is desired to work close, the incandescent lighting is much preferable, unless the arc lamps are so nicely arranged as to entirely dispel the shadow which such a powerful light is bound to create. If the plant is divided between several buildings separated at a considerable distance and the number of lamps required makes it seem desirable, the alternating system can be used to advantage, as it requires much less expenditure for copper, than the usual direct systems, not on account of its being alternating, but from the higher voltages used.

The arc system also uses the high voltage, but differs from the alternating or transformer system in this way: The arc system carries the high potential into the lamps, and contact with it (when such contact completes the circuit) is apt to be attended with unpleasant if not fatal results. The transformer system, however, while it uses high voltage to transmit the current, does not use it in the lamps, but "transforms" it down to low voltage before using it, making the lamps (which are in the secondary circuit) harmless.

Whichever system you decide upon, buy of some reliable maker, even if it costs a little more, for in the end it will pay. Even the satisfaction or assurance of knowing it is first-class is worth considerable.

Having selected the dynamo or dynamos required (and be sure they are self-regulating as far as possible) the next thing in order is to locate them properly. Do not put them where the exhaust steam or the "blow-off" will affect them, for they should be thoroughly protected from all moisture, as it is very apt to destroy the insulation of the armature and field windings. If this occurs, look out for trouble as it will not long delay its visit. Have the driving power as well situated as possible, and do not place the dynamo in such a position that the only available driving power is the shaft directly overhead. The dynamo pulley is quite small, while the pulley required to drive the machine will be of considerable size, unless the shaft runs very fast indeed. You would not think of locating any other machine in that way, yet I have seen dynamos so situated, evidently thinking anything is "good enough for the dynamo." This should not be thought of, for it requires as much care as any other important piece of machinery.

Use an ample width of belting so as not to require the belt to be strained too tight. This is hard on bearings as well as the belt.

Provide a rubber covering for the machine when not in use and see that it was covered with it. It will pay by saving many minor expenses for repairs.

Be careful to have it on a good foundation of firm, well-seasoned wood or brick (preferably the latter) and set up level or approximately so.

Extreme care must be taken to insulate the dynamo frame from the earth, as in case of a leak on the line the circuit would be completed through the machine and trouble would be sure to ensue, as well as danger of shock to the attendant. It is well to have the foundation of such a large size that the attendant cannot touch any part of the machine without standing on the foundation or platform (which must be perfectly dry).

The commutator end must be so placed as to be readily accessible, as it may require adjustment, and this should be easily accomplished.

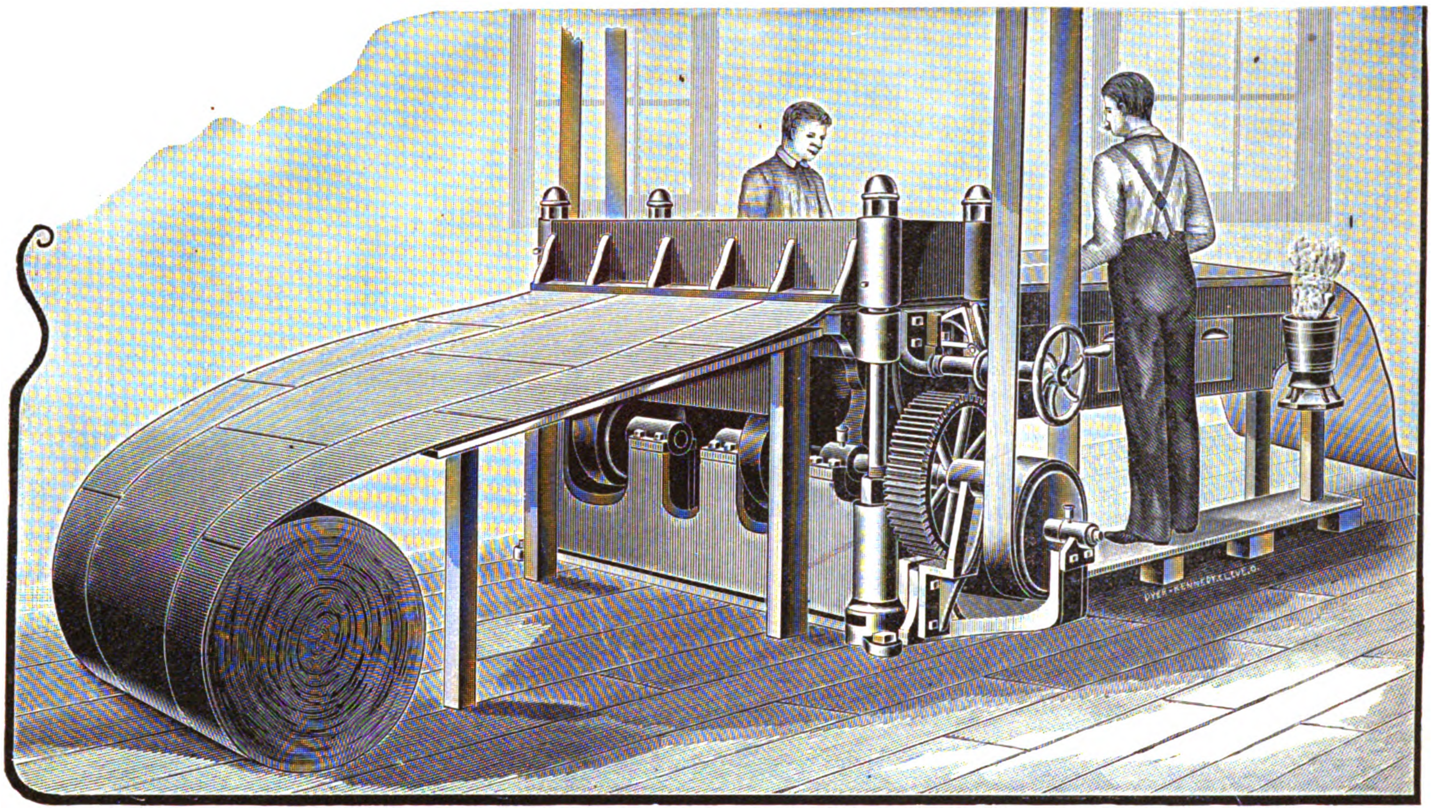
If you expect good, steady lights from your plant the power for running the dynamo must be steady, as any fluctuation in speed will affect the lights in the case we are considering, in fact in all cases unless some provision is made to counteract the effect. This will be readily understood when it is considered that the speed is the important factor in producing the correct voltage in the dynamo, after it is installed. In its manufacture other features go to affect this, but after a machine is completed the sole factor of voltage (as a rule) is in the speed at which the armature revolves. This must not be forgotten in calculating the sizes of pulleys to be used in driving the dynamo, as an increase of speed over the normal rate advised by the maker, denotes an increased voltage. This increases the brilliancy of the light, while the lamps last, but it is sure to burn out the lamps in short order. A case that came under the writer's knowledge may impress this necessity of careful calculation, for it appeals to the pocket-book, and that is a tender spot. During the Summer months the factory had been overhauled and the main shaft (line shaft) had been speeded up about five or six revolutions per minute. This was multiplied by the driving pulley of the dynamo until the machine run at 40 revolutions above speed, with a result that, in the fall, the lamps burned out in from 10 to 40 hours. They gave a splendid light while they lasted, but were exceedingly short lived. As in the case of the engine, "don't monkey with the machine until you understand the workings of it most thoroughly."

Have a good device for shifting the belt when starting up. This is important, as the belt may get caught, wind on the pulley of the dynamo or in the armature and destroy considerable before it stops in its wild career.

If you have installed the arc (or series) system, remember that the insulation of all the exposed parts must be correspondingly increased, as with the increased voltage the danger increases and must be guarded against, just as in a boiler where it is necessary to carry an excessive pressure of steam. The alternating or transformer system also requires high voltage and extra care must be taken as with the case of the arc installation. For this paper, however, we are considering the incandescent (or multiple-arc) system and will deal with that alone.

Extra care must be taken of the commutators and brushes, and the directions accompanying the machine should always be carefully studied. These may be compared to the valve motion of an engine, as their regulation governs the action of the machine in the generation of current.

All connections must be kept tight and clean. The oxide which



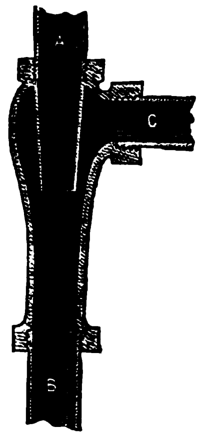
MAKING A 60-INCH HIGH GRADE LEATHER BELT.—(See page 11.)

forms on nearly all metals exposed to air or gases of any kind, is not a good conductor and prevents the free passage of the current. See that all set screws for binding the wires in the posts are clasped firmly in place and every connection in good order; it will not take long and will repay the trouble by a freedom from annoying delays.

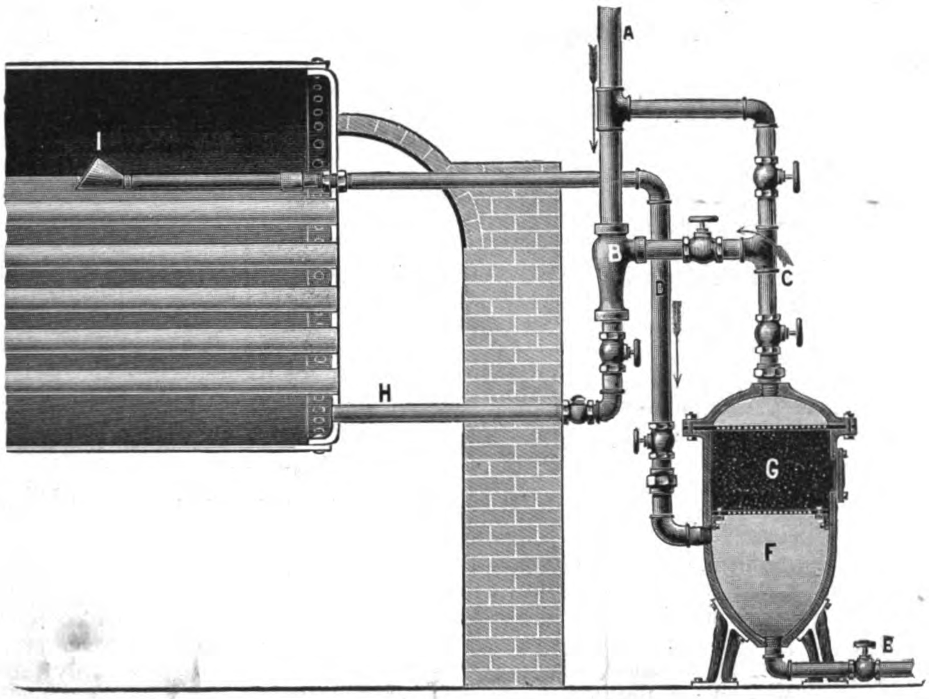
Switches and volt-meters and ammeters should form a part of the plant, for running without the ammeters and volt-meters is a good deal like running a steam plant without a steam guage or water glass. When the importance of understanding the exact condition of your plant at all times is better known, there will be less trouble with these electrical plants. Anything you do not understand about the plant, either its action or its non-action, consult the makers, if possible. If that is not possible, get some good disinterested man who knows his business, and he can locate the trouble without much doubt.

Be careful to buy the best lamps made. It is not the lamp that lasts the longest that is the most economical, but the lamp which has a moderate life and gives the full candle power at a nominal expense for power supplied to the dynamo.

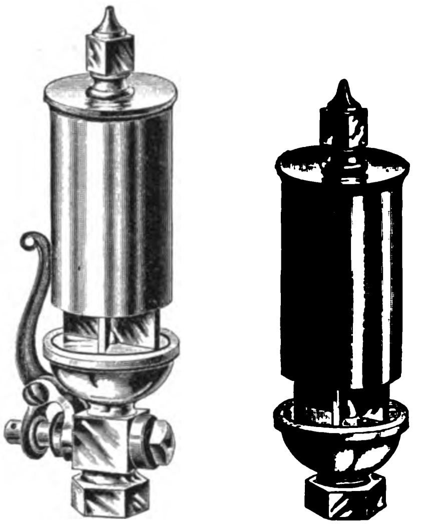
It is not economy to spare expense in having the lines erected, either. Not that any unnecessary or fancy work is advocated, but it will result in a continual loss if the lines are not properly proportioned, while if they are well calculated and erected, they will give no trouble and no energy will be unnecessarily wasted in them. Energy means power, no matter whether it be electrical or otherwise. Any energy wasted means an unnecessary cost.



Suction Tee.



THE BARAGWANATH BOILER CLEANER AND TEMPERATURE EQUALIZER.



No. 1. With Valve. No. 2. Without Valve.

A NEW STEAM WHISTLE.

It will pay you to supply your attendant (for the dynamo room) with a few good elementary books on the subject, that he may learn something of the nature and laws of instruments in his charge. If he is one who will not read at all, he is not the right kind of a man to have in charge of valuable machinery of any kind. This employment of cheap labor to care for expensive machines is an error. It is not economy, but on the contrary it often leads to an enormous expense in replacing machines that were destroyed by ignorance on the part of the attendant.

(To be continued.)

A NEW STEAM WHISTLE.

The illustrations show the new Frisbie single bell chime steam whistle, recently patented, with and without valve. This whistle produces three distinct tones, musical and harmonious. The bell is of seamless brass tubing, which being of equal thickness and absolutely smooth on inside, produces a uniform vibration, giving a clear and resonant tone. A desirable feature in the whistle is the adjustable bell. This can be raised or lowered to conform to the steam pressure under which the whistle is used. It is well known that a whistle made to blow at a low pressure, will become shrill and discordant under high pressure. By the movable bell it can be set at a point to produce a clear, full tone under any pressure, thus avoiding the disagreeable screeching not uncommon in many whistles. In case the bell, by accident, becomes damaged, a new tube to replace it, can be furnished at small expense. The valve has patent reversible lever. It is also re-grinding. By inserting a pin or wire in the hole in the valve stem, the stem can be rotated and the seat readily reground. This can be done under steam pressure. Kinsley & Frisbie, Bridgeport, Conn., manufacture it.

THE BARAGWANATH BOILER CLEANER AND TEMPERATURE EQUALIZER.

The apparatus which is represented by the accompanying cuts, is designed for use in muddy water, and for water that tends to produce foaming in the boiler. It is also invaluable in plants where for any reason it is necessary to feed cold or lukewarm water. It is, in effect, an automatic surface blow off, a strong circulation being obtained through the filtering material by the use of a suction tee placed as shown in cut. Experiments show that in actual practice the quantity of water circulating through the filter is about equal in volume to the quantity delivered by the pump. In other words every gallon of feed water pumped to the boilers is mixed with an equal quantity of water from the boilers, thereby raising the temperature of the feed to such a point that the evil effects of unequal expansion and contraction are reduced to a minimum. The strength of the circulation produced by our suction tee is such as to permit the use of a much more closely packed and therefore much more efficient filter than is commonly used in the boiler cleaners. It is cross connected in the manner shown in the cut, thus enabling the current to be reversed and the filter thoroughly blown and washed out by the current from the pump. Various filtering materials are used, depending on the character of the impurities.

A represents the feed pipe from the pump. The water in passing from the suction tee, B, draws about an equal quantity of water from the boiler through the skimmer I, pipe D and filter G, thereby greatly increasing the temperature of the water as it discharges into the boiler at H.

MAKING A 60-INCH HIGH GRADE LEATHER BELT.

The illustration on page 10 is of a machine for making a 60" belt, and is one of the largest of the kind in the country. It is not often that a leather belt 60" wide is called for. This machine is in service in the works of the Bodifield Belting Co., Cleveland, O.

FOR welding wrought iron a German chemist proposes a powder consisting of 50 per cent. of borax and 25 per cent. each of sal ammoniac and water. This mixture is boiled, being at the same time continuously stirred until it is reduced to a stiff mass, which is then, held over a fire until it becomes hard. When cold, the mixture is well pulverized and assimilated with one-third part of rust-free wrought iron fillings. The pieces to be welded are first dovetailed, or otherwise connected: the welding parts are then heated to redness, and the powder strewn over them and allowed to liquefy over the fire.

Excursion Rates Via the Big Four Route.

The following list of reduced rates is published for the benefit of the public, who will find therein general information regarding the various meetings, conventions, etc., to be held in the near future:

Quadrennial Conference of the M. E Church at Omaha, Neb., May 1–30, 1892. One fare for the round trip. Tickets will be sold April 27th to 29th inclusive, good returning until June 1st, 1892.

State Prohibition Convention at Columbus, O, May 24th and 25th, 1892. One fare for the round trip from points in Ohio. Tickets will be sold May 24th and 25th, good returning until May 27th, 1892.

Conference of German Baptist Brethren at Cedar Rapids, Ia., June 3d to 9th, 1892. One fare for the round trip. Tickets will be sold May 29th to June 5th inclusive, good returning until June 30, 1892.

Republican National Convention at Minneapolis, Minn., commencing June 7th, 1892. One fare for the round trip. Tickets will be sold June 2d to 6th inclusive; good returning until June 25th, 1892.

Supreme Lodge A. O. U. W., at Helena, Mont., commencing June 15th, 1892. One fare for the round trip. Tickets will be sold June 7th to 11th, 1892, inclusive, good returning until July 7th, 1892.

Democratic National Convention at Chicago, Ill., commencing June 20th, One fare for the round trip. Tickets will be sold June 16th to 20th inclusive, good returning until July 8th, 1892.

National Encampment G. A. R. at Washington, Sept. 20th, 1892. One cent per mile, with customary limits and side trip privileges.

Ohio Encampment G. A R Piqua, O, May 10th, 11th and 12th. One cent per mile for distance traveled. Tickets on sale May 9th and 10th, good returning until May 14th.

Presbyterian General Assembly, Portland, Oregon, May 19th to June 2d. One fare for round trip. Tickets on sale May 9th to 14th, good returning 90 days.

For further information regarding tickets, rates and time of trains call on

D. J. COLLVER, City Tkt. Agt.
JAMES DEWOLFE, Div. Pass. Agt.
173 Superior-st.

AN IMPROVED AUTOMATIC ENGINE.

(Continued from page 9.)

it is capable of being operated for any length of time without stopping, provision being made so that no lubrication of the governor is required for the bearings at M, O and P are roller pin bearings which require no lubrication and the friction is so slight as not to interfere with the sensitiveness of the mechanism. The absence of oil on the governor provides that none will get on the band wheel or be thrown over the engine room or on the main driving belt.

A test made at the works, of a 16″x18″ engine, running at the rate of 200 revolutions per minute, to ascertain what effect a light fly-wheel would have upon the regulation there was used a 54″ fly-wheel weighing 1,200 pounds and so far as could be discovered by speed indicator or tachometer it did not vary a revolution between no load and full load, neither was any variation in speed detected from varying steam pressure. The direction of rotation of the engine can be readily changed by changing the governor, provision being made for this by the cast sleeve on another arm of the fly-wheel, as may be seen in the cut and, if required, the governor can be adjusted so that the speed will increase with the load, or the reverse.

HINTS TO ENGINEERS.—X.

BY EDWIN WOODWARD.

In lining up an engine the necessary preparation before operation is to remove the back cylinder head, piston, connecting rod and cross-head pin if it can be removed. If it can not, take out the cross-head and turn the crank above the center. This will give a clear opening through which to stretch a line, which should be very strong, fine and smooth. It is usually customary to fix in the counter-bore at the back end a device of wood in the shape of a cross, with screws in each point to adjust it centrally and fasten the line to a wire loop in the center of the cross. The loop should be V-shaped with the line affixed to its apex, to prevent its being shifted from the center, the line being led through the front head, *i. e.*, the stuffing box—the cross head—and on past the crank and made fast to a suitable support near it. The line is then—if in the center of the back end of the cylinder—made central and in line with the walls of the cylinder by setting it in the center of the stuffing box for the piston. This should be very carefully done, the calipers touching the line from every side, but in no case sufficiently hard to move it. Extreme care here should be used as any error here will be multiplied in the same ratio to itself as the ratio that exists between the length of the cylinder and the length of the engine to the crank shaft. The line should be centered by the portion of the stuffing box in which the gland fits in preference to the hole in the head for the piston rod, as that is quite frequently worn out of round.

The line being parallel with the cylinder it is the guide by which to set the guide bars in line and the crank shaft at right angles with it. A level placed on the slides should show them to be level, both with and across the guides. The guide bars should now be adjusted so that the cross-head slides easily their full length and keeps its relative position as regards the line. A crooked wire fastened to the cross-head, with one end extended to the line for an index aids greatly to adjust it easily and saves much time less perfectly applied to calipering. The guide bars being now in line with the cylinder, attention is next directed to the crank shaft. Its center should be level with the line. Engines are sometimes met with whose shaft is low with no means of raising. Then all that can be done is to make the shaft level and divide the difference of the angularity of the rod if it is measurable. But the discrepancy is usually not sufficient to be noticeable, and is generally ignored. When the crank shaft is at right angles with the slides and cylinder the line should be exactly midway the length of the crank pin when at either dead center. But if in turning the crank over and back the line comes closer to the disc at one center than the other the shaft is thereby known to be out, and the shaft is out in the direction of the center which shows the disc nearest the line and the outboard bearing should be moved from that point till the crank pin measures the same from collar to line at both centers. A plumb line fastened to the crank pin and sufficiently out to clear the line should, when the crank is rotated, travel parallel with the line. If the plumb at each center is equally near the centers, the shaft is known to be at right angles with the cylinder. But if the path of the plumb is curved evidence is had that the shaft is not level. If the curve is outward from the disc it indicates that the outer end of the shaft is high. But if the curve is in the opposite direction, that end of the shaft is low.

The plumb line test should never be used except when the slides are level, for while an engine will run very well, while in line, if slightly inclined, the same engine will run execrably with the shaft levelled up and the rest left as it was.

If the practice is made to conform to the theories here enunciated, the engine ought to run without knocking, but—if the engine is of the old box bed style with guides bolted on and the crosshead fitted with adjustable shoes to take up the wear, then these shoes should be adjusted with an eye to having the cross head pin in line—exactly—with the shaft. Any error in this may be detected by disconnecting the rod from the crank at half stroke, and turning the crank pin to the back center out of the way, then if the end of the rod is equally distant from the crank disc, or the crank turn equally free into its bearing in the rod—without springing it—it is sufficiently true for ordinary practice.

When the crank shaft is returned to its normal position it usually brings the valve gear in line, but it is evident that the slides or crosshead may be much out of place without affecting the truth of this important portion of the engine, and any knock in the valve gear is most generally found to be due to badly fitted slides, rock shaft, connection pin or lost motion where connected to the valve. In the plain D valve and all valves where one valve serves to let in live steam as well as to let the exhaust out, it is necessary to give it sufficient freedom to lift from its seat when necessary, or in case the boiler should foam or prime, damage would frequently be done. Water is not so active as steam, and its very sluggishness is its evil in this case. It is important for the smooth running of the engine that the exhaust should close before the piston reaches the end of the stroke, that the compression of the steam remaining in the cylinder serve as a cushion to arrest the motion of the reciprocating parts and to start them on their return trip smoothly—and also to fill the clearance space in the cylinder and ports with steam at half the available pressure at least, as the economical use of the steam is greatly enhanced, and so when the valve closes for compression, there, in this case, remains in the cylinder a quantity of water which is practically incompressible—and it must come out or a wreck will ensue. The valve usually lifts to give it egress, and seats again with clatter and bang when the engine is over the center. It is therefore necessary to give the valve sufficient freedom to accomplish this end—and the means employed to drive the valve—whether jam nuts, compression blocks, or whatever device should have their faces at right angles with the rod, and square with the valve—and it, accurately fitted, as this weak place is more effectively concealed by superior workmanship—and its durability and noiselessness correspondingly increased.

The one important point in lining up a valve rod, is to make it parallel with the piston rod, then if the eccentric straps are in a twist or its rod too far out or in at any part of a revolution—the eccentric is by this known to be out of true, and if it loosely fits the shaft the evil may be occasioned by the set screw or key drawing only on one side. This may be corrected by a bushing on the opposite side of the shaft or a new key fitting all the way through. The eccentric having large wearing surface is particularly refractory under careless treatment.

If the binding be but slight, the surface in contact is so extensive, comparatively, that heating is very rapid and abrasion will begin as soon or perhaps before any smoke is observed. Wear makes the eccentric flat on the advancing side, while the eccentric straps wear oval in the direction of the travel of the valve. In taking up these straps to remove the knock the looseness occasions, unless extreme care is taken in the work, the liability so get it too tight and thus make a bad matter worse, is excessive, and if it is desired to know to a certainty that the eccentric will not bind and heat, it is advisable to disconnect the rod from the eccentric to make the adjustment—this course admits of turning the strap by the hand, which should be readily done, when sufficiently close, and if adjustment cannot be made without causing it to heat, then the only course is to send it to the shop for repairs.

ANOTHER VIEW OF HOW TO PROTECT INVENTIONS.

For these many years I have been interested in patents, and hence "How to Protect Inventions," by Mr. J. J. Sand, attracted my attention. The advice which he gives is partly sound and partly erroneous, and appears wholly to have been evolved out of his inner consciousness and not out of experience. It always pains me to see an inventor misled, because his lot is apt to be hard enough even when ordinarily successful. This is the only excuse I have for intruding, for I certainly have no reason for crossing the path of Mr. Sand. What I have to say is born of long experience, and is simply designed to correct what I think is erroneous in his article.

"The caveat," he says, "is not considered of any protection to a man without means."

A caveat is not any protection to a man with or without means. It is simply a notice to the Patent Office that the caveator has invented a certain thing. The design and effect of the caveat is to prevent the issue of a patent to somebody else with knowledge of the caveator. It is only designed to be of that service in case the caveator has commenced working upon an invention in which he may expect his experiments will occupy months, and sometimes years. In case of a simple invention, or one already completed, the caveat is useless.

When the invention is clear in the mind the first step should be to make a drawing or model, and the latter is best of the two. Then show it to some friends and have them put their names and the date on it, if a drawing, or, if it is a model, some identifying marks. Nothing is more unreliable than the memory of friends as to what you told them, or even what they saw, but if they can identify the thing which they saw, then the thing can speak for itself.

When you come to seek capital, beware how you go outside the limits of your personal acquaintance. Mr. Sand draws a difference between manufacturers and corporations, but manufacturers are men and corporations are composed of men. They are all looking after their own interests first.

"If you have invented something out of your line of experience, go slow." Go slow anyway, but remember at the same time that nearly or quite all of the great inventions have been made outside the experience of the inventor.

Morse was a painter—so was Fulton. Hussey was a sailor. McCormick was a farmer. Bell was a teacher of deaf mutes, and so on indefinitely.

Another thing must be remembered—no invention is wanted—the demand must be created. Every invention is for a new thing, not before known. How shall people want for something they know nothing about? If it is really a good and useful thing the want may be created. If it proves not to be good and useful the want cannot be created. This is subject to one exception. Some inventions are good and useful, but so far in advance of the time, that the patent expires long before the want arrives. An instance is in mind. The self-binder first made an impression in the market, and its manufacture was commenced by Mr. Locke in 1864. The next year Walter A. Wood took up Locke's invention, and the binder has been an established institution ever since. Yet the first patent (and many succeeding ones) for self-binders using the identical mechanism for fastening the band, had already expired. The first binder inventor encountered an industrial condition which did not warrant the substitution of machinery for hand labor.

Hazard Knowles invented the first floating bar mowing machine, and for two or three years it was exhibited in the rear of the Patent Office, in Washington—with no takers. That was in 1837. Twelve years afterwards Jonathan Haines invented it again, and it thereupon took a permanent place in the arts.

"Any patent obtained through any of the various patent agencies is of no value unless the claims are made out by some person well up in the particular branch of art to which the invention belongs." If you wanted a deed drawn for a piece of land would you go to a farmer for it? Not by any means, but to a skillful conveyancer. He may never have spent an hour on a farm, but he may know how to draw a deed. If you wanted a contract drawn covering a number of intricate operations, mechanical or otherwise, would you go to an artisan or to a lawyer for it? The patent is a deed covering an invention. It is not the invention any more than the other deed is the land—and the man who made the invention is no more capable of describing it correctly and technically than the farmer is capable or drawing his deed, unless he has learned the other trade, too. And then, with all due respect, if he attempts it for himself he will probably be like the lawyer who pleads his own cause—have a fool for a client.

The very fact that the invention is the product of a certain train of circumstances tends to limit the inventor's conception of its full scope and nature. The attorney who is fit to draw up an application for a patent, receives this invention as a virgin field and with wits sharpened by practice to detect the true principle and possibilty. There probably is not an instance of a really notable invention which would not have fallen short of its mark if the claims had been drawn by the inventor.

If all patent agencies who procure patents for a fixed price, are frauds, then are they all frauds, for that is the universal custom—subject only to the reservation that cases of universal difficulty or magnitude may be subject to extra charges. Mr. Sand appears to have had experiences in a contingent fee office. The solicitor who gets his fee in advance has no tendency to draw narrow claims for he is working for reputation only. If Mr. Sand had had much experience in patent litigation he would hardly have concluded that "almost any agency is good enough, if the claims are drawn up by the inventor." He would have soon discovered that when the blind lead the blind there is danger of the ditch. Of course, the claims should be drawn in the broadest manner—but what is a broad claim? I doubt if any answer to that question can be found, even in the century dictionary. It depends upon *conditions in the case*. The broadest seeming statement of the claim may be narrowed to an insignificant interpretation by something which is in the specification or by an emission to put something in which might have been there. An apparently narrow statement of the claim, may be interpreted broad as the ocean if the specification is all right.

The advice to search for ways to get around the claim is all right, but it will seldom be done by the inventor, and in the hands of the skillful attorney it is a part of his regular duty, and when he fails to do so adequately it is the result in a majority of cases of the inventor's inability to impart what he himself knows about the invention and its mode of action.

The commissioner will undoubtedly send copies of the rules on application. They impart all needful information as to *essential forms*, but for helps to indicate what should be put into the specification and claims they are valueless.

If any man wants a patent which will be good for something in court, he had better employ an attorney who knows how to prepare and prosecute the application, and refrain from monkeying with the papers himself.

That is the advice of a pretty old stayer. R. D. O. SMITH.

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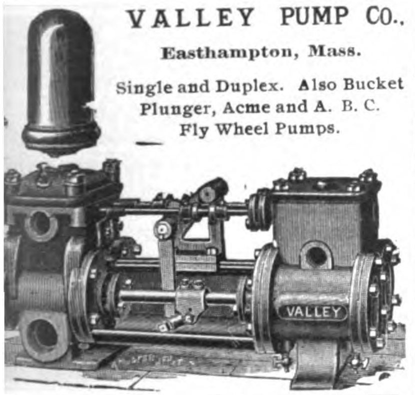

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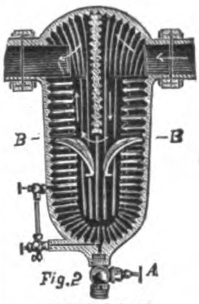

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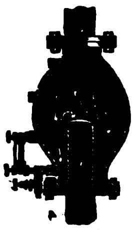

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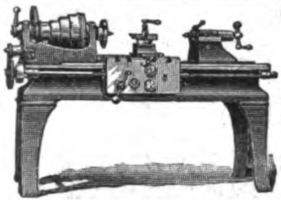

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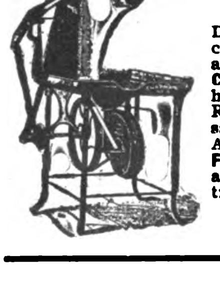

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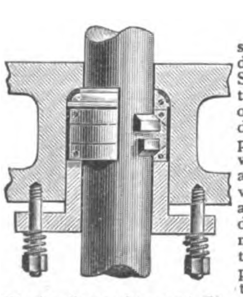

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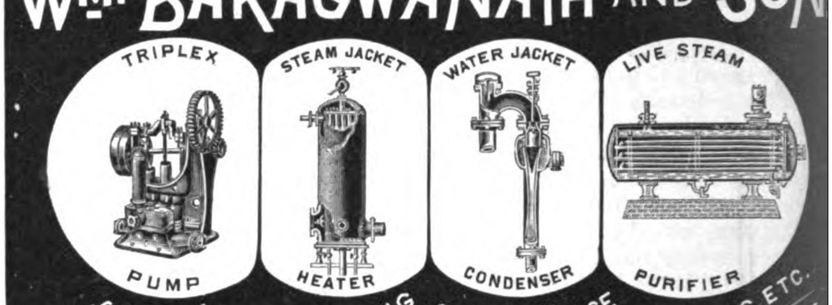

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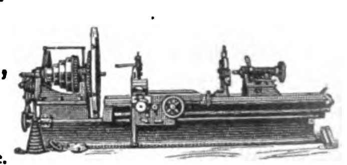

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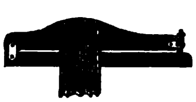

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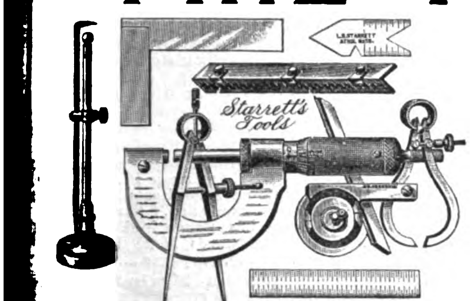

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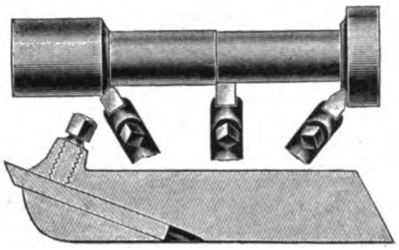

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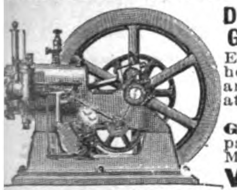

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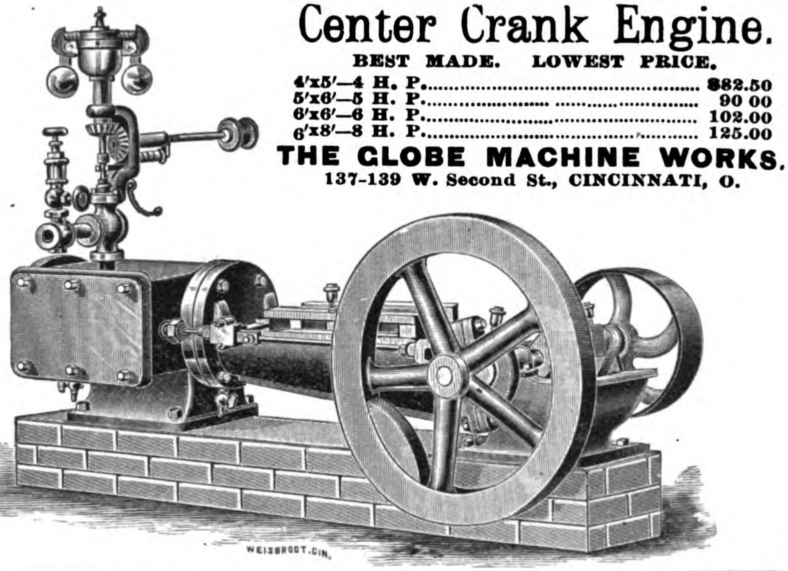
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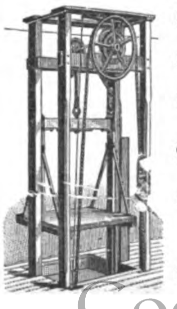

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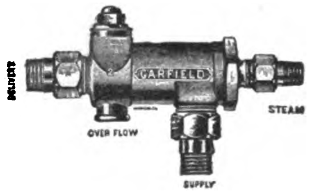

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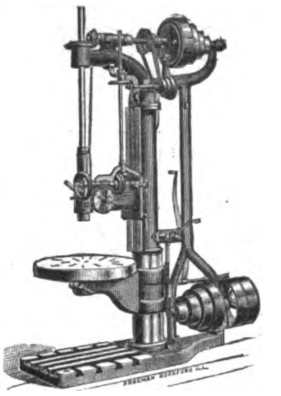

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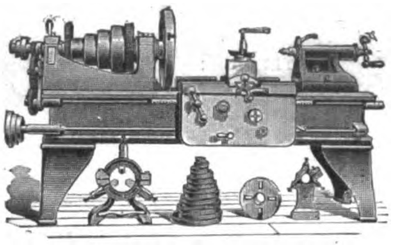

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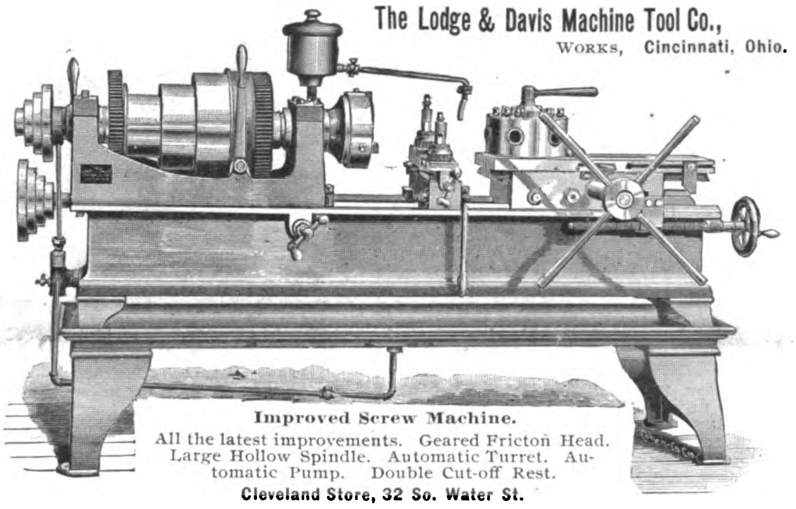

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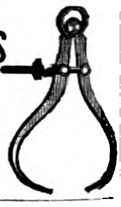

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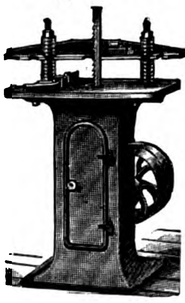

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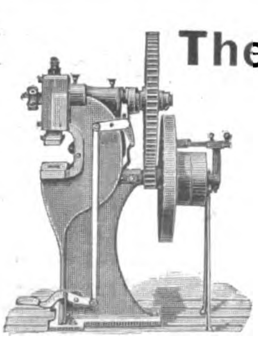

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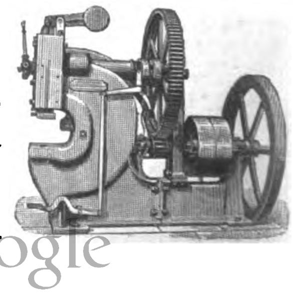

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THE BATES CORLISS ENGINE.

The engine shown in the accompanying illustrations possesses some ovel features which increase the simplicity and assist in obtaining a very igh efficiency. Fig. 1 shows the front view of the engine, where it will e seen that it has a light girder frame, but containing sufficient metal and o strongly braced as to prevent any injurious springing while in operation. he guides form a part of the frame, and are bored out so that they are

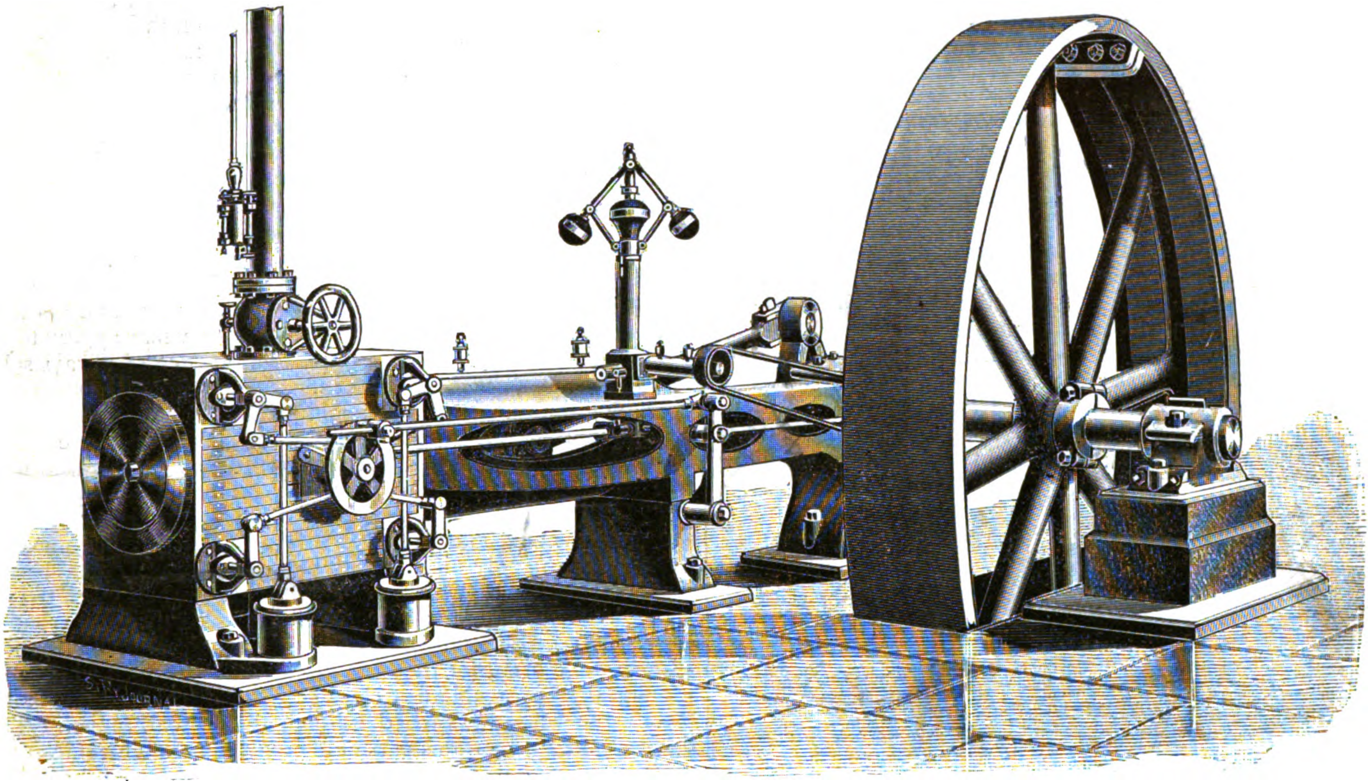


FIG. 1.

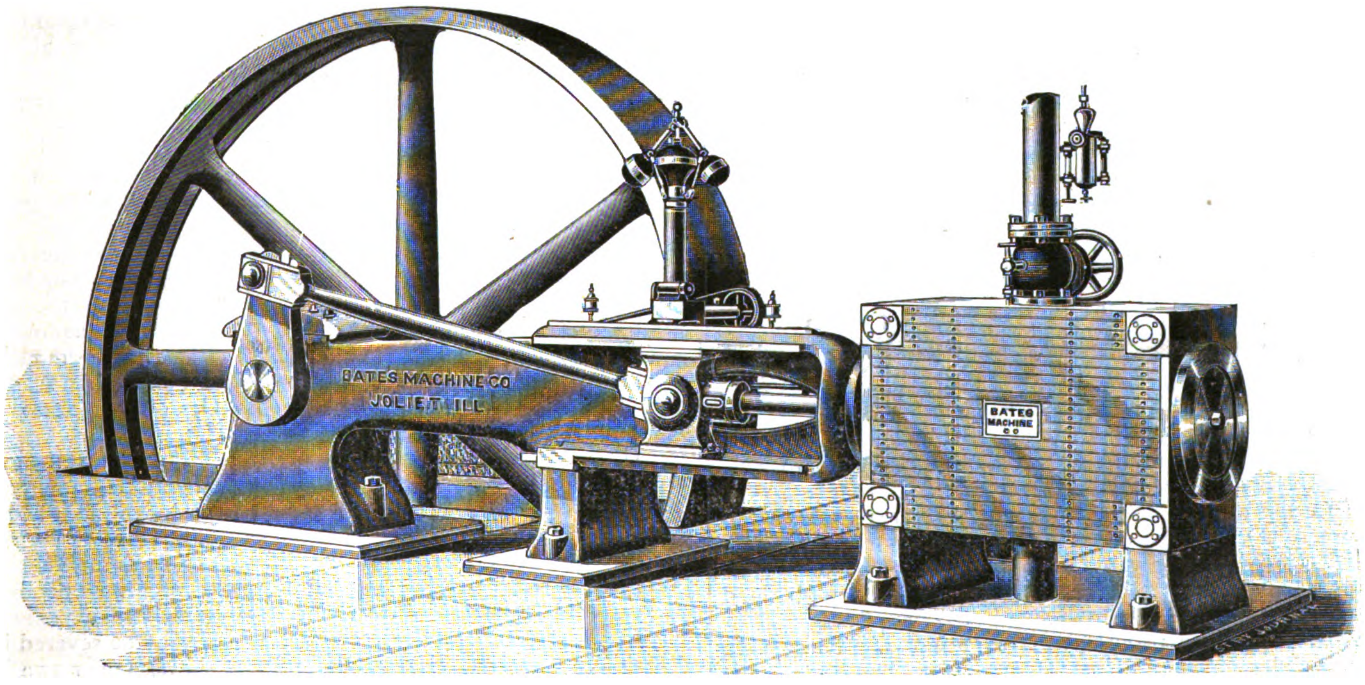


FIG. 2.—THE BATES CORLISS ENGINE.

ectly in line with the center line of the engine and not liable to become rn out, as the wearing surfaces are sufficiently large to prevent undue ar. The main pillow block, frame and guides, are all cast in one piece d the center leg, with which the girder is provided, supports the guides d extends to the extreme outside of girder.

Fig. 2 shows the back of the engine, with valve gear, governor, etc. will be seen that the releasing gear on this engine is of a different form m other engines of similar appearance, as the tripping or releasing takes place at the wrist plate, which much simplifies the mechanism. Fig. 3 (page 5) gives a view of valves, valve gear, dash pots, etc., where it will be seen that the mechanism lacks some of the complications found in other engines of the same type. Besides the ordinary rotary valve, a special admission valve is made, which is applied in line with and parallel to the the seats, which prevents uneven wear, as they cannot rock or twist themselves. Another improvement which is introduced on the larger engines made by this company consists of a separate eccentric, which enables the cut-off to take place at any part of the stroke. This device is essential for rolling-mill engines or those designed for other work where at times they are called upon to develop an unusual amount of power.

The main shaft is made of hammered wrought iron, and its diameter is one-half the diameter of the cylinder, for engines of ordinary power, but for heavy-duty engines this proportion is increased. The regulation is obtained from a fly-ball governor, operating through the usual mechanism,

(Continued on page 5.)

Electrical

Electrical Lessons for Machinists and Engineers—Concluded.

We have to call your special attention to another form of armature called, after its inventor, the Gramme ring or drum, as it and many modifications of it are very extensively used.

This armature consists of a ring or tubular piece of soft iron which fulfills the duties of the Siemens H core. Around the ring is wound any equal number of coils or insulated wire, all of the same length and resistance, or the wire may be in one continuous spiral Gramme employed simply as a plain ring. Mr. Brush, of this city, may be said to have made an improvement on this by cutting channels therein to receive the wire coils. Hundreds of others have also made similar modifications, with results as various as the modifications, the object of some of the designers apparently being to evade Gramme's claims made in his patent. This patent has now expired, and many of the best makers are to-day satisfied to use the old form of armature without any modification in the machines they are constructing.

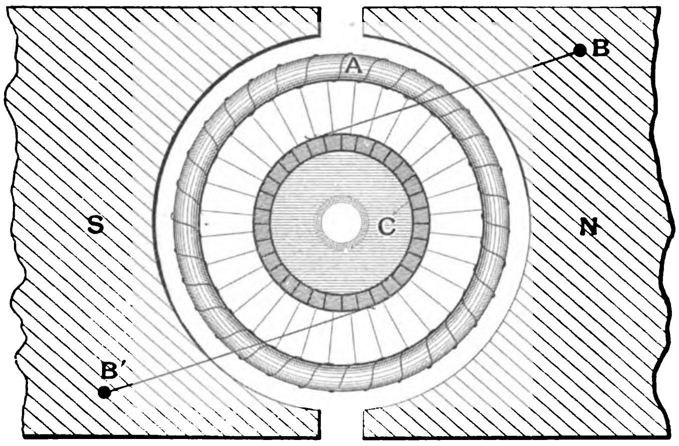
Were it not for the trouble of winding, which to an amateur is a tiresome process, we would recommend this form of armature to those of our readers who intend to construct a machine for their own use in preference to the Siemens.

We have no intention to dwell upon the many modifications, as it would simply confuse our readers, and in these short lessons be of no practical use, but otherwise, as very many of the so-called modifications are less effective.

It is essential that the Gramme ring armature be thoroughly understood, and to make it more clear, we have introduced the accompanying cut, Fig. 1, and repeat that it consists of a ring or drum of soft iron, preferably built up of thin discs, or rings securely fastened together, through and around which is wound the wire.

In practice it is found that a solid iron core does not give such good results as one built up of separate plates insulated from each other.

In Fig. 1, S N represent the poles of the field magnet, which enclose the armature as completely as possible without short-circuiting the magnetic lines of force. The gap between the two field poles should be only sufficient to prevent the lines of force escaping by passing from one pole to the other instead of passing through the armature. The best results are obtained when the greatest number of lines of force are obtained and cut by the revolving armature the greatest number of times in a given period.



The more lines of force passing between the poles of the field magnet, and the more rapid the rotation of the armature, so in proportion will be the output of electric energy. If any of the lines of force escape through the air space separating the poles or elsewhere, the energy obtained from the machine will be proportionately less, as the number of lines of force are lost by the short circuit. Any of the very numerous methods of winding the sections of wire on the armature may be employed so long as they cut the lines or force emanating from the fields.

It is the custom of many makers to wind on the ring 32 equal coils of wire, the ends of which are carried to 32 metal sections on the commutator, as shown in the figure. It is the same as winding the ring with a continuous wire and metallically connecting thereto at 32 points equally divided, 32 short wires which are soldered one to each section of the commutator.

In the figure, S N represent the field poles; B B' the brushes which carry and collect the current from the commutator C, and A represents the armature core with coils of wire wound thereon.

In proportion to the amount of steam or other energy expended in driving the armature of a well-constructed dynamo, so in proportion will be the amount of electric energy given up by the dynamo. The conversion of steam or mechanical energy into electrical energy is often obtained at a loss only of 10 per cent.

Any good dynamic machine may be used as a motor. There is no difference in the principles governing their construction, but there are a very great number of motors, varying, in form, one from the other, but the same simple principles underlie each and every one. The electric motor was an accidental discovery, and it has done more than anything else to prove that the conservation of energy is a fact.

One thing has occured to us and that is that it would be better, before going further into the details of the construction of dynamos and motors as intended, to give a few of the most important points and facts relative to planting, running and manufacturing them.

There are many faults liable to arise which, although apparently trifling in themselves at first, may at any moment, if neglected, result seriously and perhaps in a complete destruction of the machine.

We will direct your attention to some of the most common faults, and explain how best to remove them, and how by ordinary care they may be avoided altogether.

The sparking at the brushes, a very common fault, may be due to any one of the several causes, such as bad contact between brushes and commutator, by reason of the brushes pressing too heavily or too lightly or unevenly on the commutator, or through bad adjustment, or the parts being overheated or worn away. The proper position and pressure of the brushes on the commutator can best be found by shifting them until the least sparking and best results are obtained. When the brushes become worn away unevenly they should be turned over, or the ends should be trimmed off evenly.

The commutator should be frequently oiled to prevent undue wear and friction, which means heating, and heating is a very objectionable fault. The oil, however, must be of good quality and very sparingly applied, as otherwise it will introduce resistance, sparking and, perhaps, open the circuit.

Bad adjustment of the brushes means loss of current on the outside circuit, and consequently a diminished light.

The slipping of the driving belt is a thing of too frequent occurrence in small electric plants; it is due to one or the other of several causes. In some instances it may be remedied by using a long and broad belt, a little tighter than used for ordinary work.

The perfect insulation of all wires is one of the most important facts to be considered. A very trifling leak from one wire to another may instantly terminate in the destruction of the machine, so far as wiring is concerned. For this reason too much care cannot be taken in insulating the wires from each other and from every other part of the machine.

The contact or short circuiting of the wires or a contact between wires and pole pieces may, by dividing the current, act in such a way as to cause the machine to give but a fractional part of the energy it otherwise would do. The careful insulation of the wires forming the circuit is a point to be carefully watched; use no bare wires and avoid the use of metal staples in fastening against walls, etc., but use in place thereof fiber staples, or, better still, wood clamps or cleats.

The most troublesome faults in any and every electric installation, whatever its application, is bad joints. Joints that are loose, unless well soldered, often times do not make metallic contact and at other times they do, yet so far as can be judged by the eye they may appear to make perfect contact. Therefore it is wise to make a practice of always soldering joints and to make sure that the solder flows freely. To show the necessity of practicing the utmost care in joining wires, we will digress a little to relate a troublesome fault which occurred on a telegraph wire while under the supervision of the writer. An intermittent fault showed itself on a wire which was bringing in from $200 to $300 per hour. The fault appeared for a few minutes a time only, but several times a day and frequently about the same hours. The line was carefully tested and appeared perfect in every way, the only difference to be detected was a very slight one in the metallic resistance, which was slightly higher than when the line was first erected. The wire was partly overhead and partly underground and passed through a railroad tunnel which was about one mile long. After a long and careful search, for the fault would not show itself when we were watching and thereby enable us to locate it, we discovered the fault in the joint where the wire was carried through the railroad tunnel. The vibrations due to some of the trains passing the point was often sufficient to break the metallic contact at the joint and the vibrations from the next train would probably bring the wires together again, or they would come together through some other cause. Our readers can not begin to imagine the annoyance and trouble such a fault will cause on a telegraph circuit. On any electrical circuit such a fault will give endless trouble so long as it exists. As a precaution do not neglect to solder your joints well. Rubber tape is generally used to cover the joints after soldering to insulate them.

The wires used in the construction of dynamo and for connecting dynamos and lamps, etc., should be of the very best quality of copper and the leads should be of a gauge large enough not to become heated and offer much resistance. A No. 14 B. W. G. will do for one or two lamps on a short line. A high resistance wire means loss of electric energy, as the electric is converted into heat energy in the wires. The heating of the wires indicates that they are not heavy enough to do the work they are taxed with. Wires should on no account be fastened against damp walls.

The dynamo should be set upon a solid and level foundation, preferably on an adjustable wood bed, so that the whole can be readily moved to tighten or adjust the belt as required. On both dynamos and motors always use sight-feed lubricators.

Do not start a dynamo until you have satisfied yourself that everything is in perfect order and adjustment. The dynamo, if required for arc lighting, should be series wound, and if for incandescent lighting it should be shunt wound.

The wire for the arc light circuit should be in one continuous loop. Then to connect a lamp at any point it will simply be necessary to sever the wire and connect the ends to the terminal or binding post on the lamps.

The wire for the incandescent circuits should be severed in the centre of loop and the wires fixed parallel to each other, one or two inches apart.

GRAPHITE PAINT.

For Tin or Shingle Roofs and Iron Work It is Absolutely without an Equal.

A tin roof well painted will not need repainting for 10 to 15 years. If you need any paint it will pay you to send for circular.

JOSEPH DIXON CRUCIBLE CO.,
JERSEY CITY, N. J.

Mention this paper.

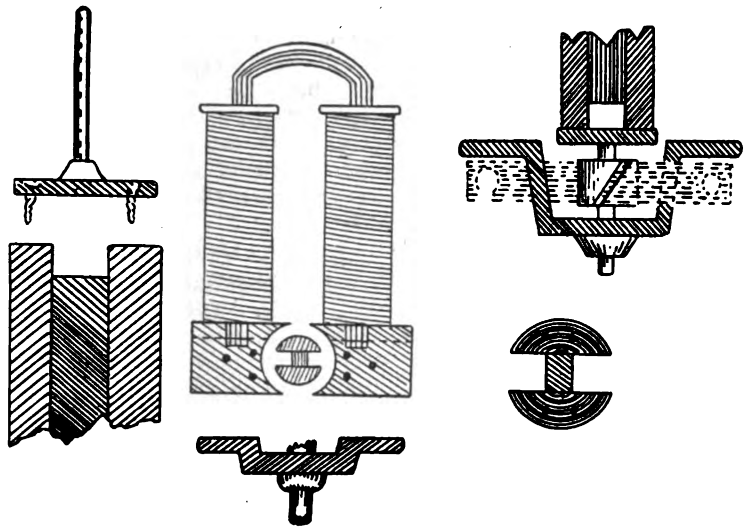
The lamps should be connected so as to bridge across from one wire to the other.

HOW TO MAKE A DYNAMO.

We recommend the cylindrical armature on account of its simplicity and compactness, and because it takes less labor, skill and wire. We must again repeat that we do not recommend it for heavy and continuous work.

The armature core should be as long and its diameter should be as large as can be made convenient within its limits. If for low potentials, the armature should be longer and smaller in diameter than for high potentials.

In the ∩-shaped figure, in the accompanying illustration, the ends entering the base show the field magnet cores and pole pieces as fitted before winding on the wire. The ∩-shaped piece is built up of 12 thicknesses of the best Norway sheet iron 1-16″ thick. The sheet is cut into 12 strips, each measuring 26″ long and 5½″ broad. The sheets are then formed and riveted at points to keep them together; the space between the legs being 5″. The legs are them trimmed off and made perfectly true, after which a thick cardboard flange is put around each leg 9″ from the bottom and another 1″ from the ends. The iron sheets between the flanges are then well varnished with shellac varnish and afterwards covered, preferably with silk, laid on evenly and two or three layers thick. Parchment or parchmentized paper can be used for this purpose or paraffined or varnished cotton cloth. Each leg is now wound between the flanges with five layers of No. 20 double cotton covered wire. The field magnet coils are so far completed.



The pole pieces, which are also to be made of the best Norway iron, should be 6″ long, 3″ broad and 2½″ thick. The simplest way to form these pieces is to take a piece of iron 7″ x 6″ x 2¾″ and drill a 2½″ hole through, leaving ¼″ of iron top and bottom, which when sawed through, will give you the two pole pieces. The extra ¼″ thickness will make no difference. Slots are then cut 1″ deep and just wide enough to permit of the ends of the field magnet cores being driven therein and afterwards screwed or bolted together. The pole pieces will now be 6″ long, 3″ broad and 2¾″ thick. When thus far completed the whole should be well planted and bolted through the pole pieces to a hardwood base, which should not be less than 18″ square and 2″ thick, and this base should, when the machine is fixed for use, be bolted firmly to the floor.

The armature core should be made of 2½″ round Norway iron. It should be 6″ long and have a slot planed or cut through its entire length and in two opposite sides exactly in line with each other. The slot should be 2⅛″ wide measuring on the outside circumference, and 1¼″ deep measuring from the highest point of the circumference. The metal in the center of armature core should be cut away for 1½″ at each end. The armature core proper would thus be reduced to 3″, while the pole pieces would be 6″.

The ends of the armature should now be trued up and turned to receive or be received and fitted into a brass flange. These flanges have screwed and riveted in their centers the shaft of ⅜″ steel upon which the armature revolves. When the armature is balanced and fitted and made to run true, the flanges are screwed to the armature by means of four countersunk screws in each.

The shaft on one side is 2″ long and on the other side 2¾″. Upon the latter and longer one is fitted the commutator, which consists of ¾″ or 1″ brass tube, driven upon a piece of hardwood to which it is firmly screwed with short countersunk screws. When firmly secured, the metal tube is cut by means of a saw across, a little diagonally, into two exactly equal parts. Care should be taken that not a particle of metal in the shape of filings or dust remains in the cut, as such will give considerable trouble and annoyance. The slots should be filled with mica to prevent the possibility of this occurring.

The armature is complete now, with the exception of winding. It must be carefully trued in a lathe between centers. The flanges and shafts should now be removed and the armature wound with double cotton covered wire, No. 22. The winding must be even and each convolution pressed tightly against the next. To wind the armature it should be centered at right angles to the lathe and made to revolve lengthways. Before winding the armature is painted within the slots with shellac varnish and strips of silk or paper laid evenly around so that the wire can by no possible chance touch the iron. Be careful to have no metal filings about, as such getting into your wire will make it useless.

When the channels are completely filled with the wire until the armature takes the cylindrical form again, the wire being slightly within the radius of the iron, the flanges are replaced, the two ends of the armature being passed out through two holes in the flange, which have been previously bushed with hard rubber or fibre. These wires are carried to the commutator and soldered to the different halves thereof.

The armature is now complete, and must be mounted so as to revolve between the pole pieces of the field magnets. A strip of brass 1½″ wide and ½″ thick is screwed across the ends of the pole pieces on one side, the center of this is drilled to receive the armature shaft. On the other side the armature shaft also carries the commutator, so that the yoke piece, which forms the bearing of the shaft, instead of being straight across is bent out at right angles, so as to leave ample room for the commutator to revolve. On each side of the commutator, on the brass yoke, a saddle of hard rubber strides and is firmly screwed thereto. The hard rubber carries the brushes, which take off the current from the commutator.

The figures given here and those given in a previous issue will, we trust, make our description sufficiently clear to enable any machinist to build a good dynamo machine.

In designing a motor, weight and size are important factors, whereas the weight and size of dynamos are of little consequence. The dynamo designer aims to obtain the conversion of the whole of the steam energy expended in driving it into electric energy, regardless of dimensions. The designer of the motor aims to convert the whole of the electric energy into mechanical energy with due regard to size and weight. We have already stated that there is no actual difference of construction between a dynamo and a motor. A good dynamo will generally make a pretty good motor without any modification whatever, and with slight modifications the good motor may be made a good dynamo.

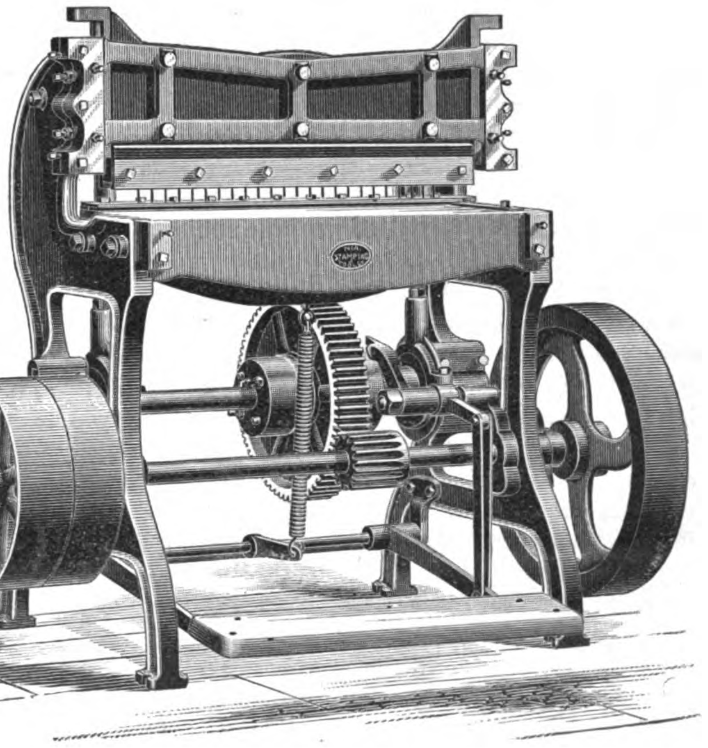
A machine built as directed above will not make the most economical dynamo, neither will it make the most economical motor, but it can be used for generating electricity, *i. e.*, convert the energy expended in driving it into electric energy less the loss by friction and imperfections of construction, for lighting lamps or driving motors, or, connected to a more powerful generator, it may be used as a motor. The dynamo machine therefore proves better than anything else the truth of the conservation of energy.

The only thing to be done to make a dynamo a motor is to connect its terminals to the terminals of another and more powerful dynamo. To make a motor a dynamo it is simply necessary to revolve its armature as the armature of a dynamo connecting the leads to lamps, etc., to the binding posts in place of the wires from the dynamo.

GANG PUNCHING MACHINE.

The gang punching machine here illustrated, which has just been brought out by the Niagara Stamping & Tool Co., of Buffalo, N. Y., is designed for punching a row of holes through sheet metal at one operation. The standard size is 30 inches long with a two-inch throat. This permits sheets of unlimited length being punched all along the edge.

The back-geared power machine illustrated punches 24 holes $\frac{8}{16}$ inch in diameter through No. 16 gauge iron. The back gauge is adjustable and a side gauge gives the exact distance from the last hole punched for next operation. The punch and die plates can easily and quickly be removed, and others substituted with punches of different size and location. Single punches can be replaced in case of breakage. The machine is provided with an improved combined pin and friction clutch, whereby the punch will make but one stroke at the depression of the treadle and then stop until the treadle is again depressed. Special attention has been given to the stiffness of the machine, combined with simplicity of construction. Lever machines are suitable for punching a limited number of holes through No. 16 iron.



An instrument has been invented in Germany by which the profile of a river bed may be taken automatically with sufficient accuracy. A curved arm rests on the bottom of the river, and, by means of a recording mechanism, the depth is automatically and precisely registered on a revolving drum.

SCIENTIFIC MACHINIST

Formerly, WESTERN MACHINIST.

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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain or brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, JUNE 1, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

THE SUBTERFUGE OF A GREAT MONOPOLY.

The public has been interested in the reports that the patents under which the Bell Telephone Co. operate will soon expire. It is generally believed that this monopoly has spent millions in influencing legislation and judicial decisions to perpetuate itself in the control of the transmission of speech by wire. It is believed to possess all the evils of a monopoly with none of the advantages—if there ever are any advantages in monopolies. The opinion of the *Electrical World* may well be taken on the question of whether there is truth in these opinions held by the public. In a recent issue that journal says: "We have been suffering for years with a very unsatisfactory telephone system operated purely for money without regard of the kind of service." Other electrical journals speak in similar language.

The agitation that now brings the Bell monopoly before public notice is a subterfuge that has been resorted to by that company and Mr. Edison to continue the life of an important patent. About fifteen years ago he applied to the patent office for letters patent on a carbon transmitter. A few years before that time Berliner had taken out patents on a smilar invention, both in this country and in England, which was sold to the Bell Co. in America. The Bell Co. began interference proceedings to prevent, ostensibly, the issue of any kind of a patent to Mr. Edison on this device. It became evident, after a while, that it was not the wish either of Mr. Edison or the Bell Co. that the patent office should take final action on this application. There was a sham fight kept up to hold the matter in abeyance. A short time ago the patents were issued, and it is the hope of the Bell Co. that the latter patents may be sustained, thus giving the owners protection on the transmitter for 17 years more, as they own the Edison as well as the Berliner patents. There are a good many fine points and details about these patents that we will not here discuss. But if public sentiment has any influence in securing justice we think that there should be no doubt, when the facts are appreciated by the people, about the defeat of this trick. If this monopoly was not a very objectionable one there might not be so strong a public sentiment against allowing them to control the telephone business any longer than the life of the original patents, through technicalities. But even the electrical journals condemn them. They have no friends. A considerable number of millionaires have been made by this company and the telephone business has been conducted very poorly. The rates are extortionate and the service most wretched. Enough has been paid to the inventors and the original capitalists who invested in the patents. This immense corporation, seeking its own aggrandizement, will resort to its numerous "ways that are dark and tricks that are vain," but we hope that the feeling against them has defeated them in advance.

ONE of the most recent novelties is a house stove introduced in England. The grate is swung on trunnions and can be reversed. After fresh coal has been added at the top, the reversal is made, and the green coal is thus brought to the bottom in an easy manner, to answer the purpose in question, namely, the gases from the coal, passing upward by means of this arrangement through the red portion of the fire, previously at the bottom, are almost consumed before reaching the chimney.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(374.) E. A. Collins, Exeter, N. H., writes: 1. "I am running two 54″ return flue tubular boilers. They are close up together. The one next to the engine will have 75 pounds, but the other always shows 5 pounds less to the square inch. Both gauges are tested, and said to be right. What is the reason? 2. How much lead should a slide valve have to a 12″x24″ cylinder, valve travel 1½″? 3. Where can I get a book that treats on electric batteries?" *A.*—1. We should say that the trouble is in the gauges. They may not have been tested properly, or one may be in a very warm place, and the difference in the temperature may be considerable, causing the one in the hottest place to register incorrectly. 2. Give enough lead to get full initial pressure at the beginning of the stroke, also the proper cushion. We should advise you to try 1-32″, and to increase or decrease as it may require. It must be regulated according to the engine, as stated, and in this way you can get exactly the right lead. 3. Write to the publishing house advertised in the May 15th issue, on the last page. Their catalogue embraces every kind of technical and scientific literature.

(375.) B. H. S., Timberville, Va., asks: "What is the difference between green and dry sand cores?" *A.*—Green sand cores are made of regular molder's sand, the same as the mold is. The dry core is made of sand mixed with flour, and a preparation, sometimes consisting chiefly of molasses, and baked. The baked cores are put in place after the mold has been made from the pattern, but the green generally are molded from the pattern with the other parts.

(376) Wm. G., Newport, Ky., writes: "Please let me know in your next issue how bronze is made for shot-guns, also explain how it is put on the gun barrel. If you can't tell me, perhaps some of your readers can do so." *A.*—"The Mechanic's Complete Library" gives the following: "Mix 16 parts sweet spirits of niter, 12 parts saturated solution of sulphate of iron, 12 parts chloride of antimony. Bottle and cork the mixture for a day, then add 500 parts of water, and thoroughly mix. Clean the barrel to a uniform grain, free from grease and finger stains. Wipe with a staining mixture on a wad of cotton. Let it stand for twenty-four hours, scratch brush the surface, and repeat twice. Rub off the last time with leather moistened with olive oil. Let dry a day, and rub down with a cloth moistened with oil to polish.

(377.) W. B. M., Dee, Pa., writes: "I have become much interested in the 'Questions and Answers' in the MACHINIST, and as others come to you for help, do not see why I should not also. It became necessary in the course of my work to use wood pins, 5-16″ in diameter, round and true. The company for which I work, having the power, did not wish to have the work done outside, so the next move was to make a machine to do the work. After making a shaft, and drilling a hole through and setting in bearings, I next made a head with three knives, but with all I could do it would not work. The next move was to use but one knife. This was much nearer than the former, yet it will not work on soft wood. Will not make a smooth cut, but rather pulls the wood than cuts it. Now, Mr. Editor, or any of your readers, will you tell me what is wrong with my machine? The speed seems to be high enough." *A.*—We can not from the description you give, tell what kind of a machine you have and how it is run. If you set the knives right, do not try to cut against the grain of your wood, and run your shaft at the proper speed, which should not be less than 2,500 revolutions per minute, you should do satisfactory work. If a new machine is being built, we would recommend that it be constructed on the plan and run on the principle of a sticker. It should be run at very high speed.

(378.) A. M. asks: "A slide valve may lift off seat by having the valve too tight between the nuts, but why should a Corliss valve lift off of the seat? Please answer in your next, and oblige." *A.*—You may have too much compression on the exhaust end.

(379.) Geo. Dalrymple, Fair Haven, Vt., writes: 1. "I have in my works one 35 H. P. stationary boiler, furnishing steam for one 10 H. P. engine. The engine is not large enough to do my work. I want about 5 H. P. more, or 15 H. P. would be sufficient for all purposes. Now I have on hand a 35 H. P. stationary plain slide valve engine that I would prefer to use instead of buying a new one to do my work, and I want to know if I could use this 35 H. P. engine by running it slower, or would it be economy to buy an engine of the required H. P.? 2. If I should use this 35 H. P. engine, what would be the proper speed to develop the best results?" *A.*—You can use the larger engine just about as well. It should be run at about 500 feet piston speed per minute.

(380.) R. G. Zemmer asks: "Please write me through your next paper how long a keel condenser I will have to have on my yacht. The engine is a compound 4½″x8¼″ and 6″ stroke. The condenser that was on last year was 15 feet long and 2″ pipe, and I could not get the vacuum that I ought to have had. Ten inches were the most I could get." *A.*—Twenty-four feet of ½″ pipe, 12 feet each side of the keel.

(381.) F. W. writes: 1. "Will you kindly answer through your valuable paper the following: In a compound engine, one engineer claims there should be a back pressure maintained between the two cylinders.

The second claims none should be allowed at all, and the third says a vacuum should be maintained. Which is right, and why? 2. I understand one pound vacuum to equal 2" of mercury. Now, what is this mercury, and how is this measurement ascertained? Again, if we have a boiler with, say, 100 pounds of steam to the square inch on it, and I have a pipe 1" in diameter tapped in the top of the boiler and filled with water, how high must the pipe be to cause the water to force back the steam and enter against the 100 pounds pressure? Please give a rule for this that will answer on any size pipe." *A.*—No. 1 is right. There is no use in a low pressure cylinder if there can be no pressure on the piston, when the valve opens, to the extent that when the exhaust valve opens on the low pressure cylinder the pressure is at about or a trifle below the atmospheric pressure when it exhausts into the condenser. 2. Thirty inches of mercury counterbalances the pressure of atmosphere 14, 7-10 pounds on each square inch. A column of water 1" in area and about 33 feet high counterbalances the atmosphere. As 2 1-5 feet of water weigh one pound, to overcome 100 pounds pressure it will require a column of water 220 feet high. The same will be required of a pipe any size.

☞ Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

THE BATES CORLISS ENGINE.

(Continued from first page.)

and maintain an unvarying speed so long as the power of the engine is within the capacity of the steam.

The manufacturers of this engine place it upon the market with the ssurance that it will meet all ordinary requirements, and for unusual puroses their special engines are made to meet the requirements.

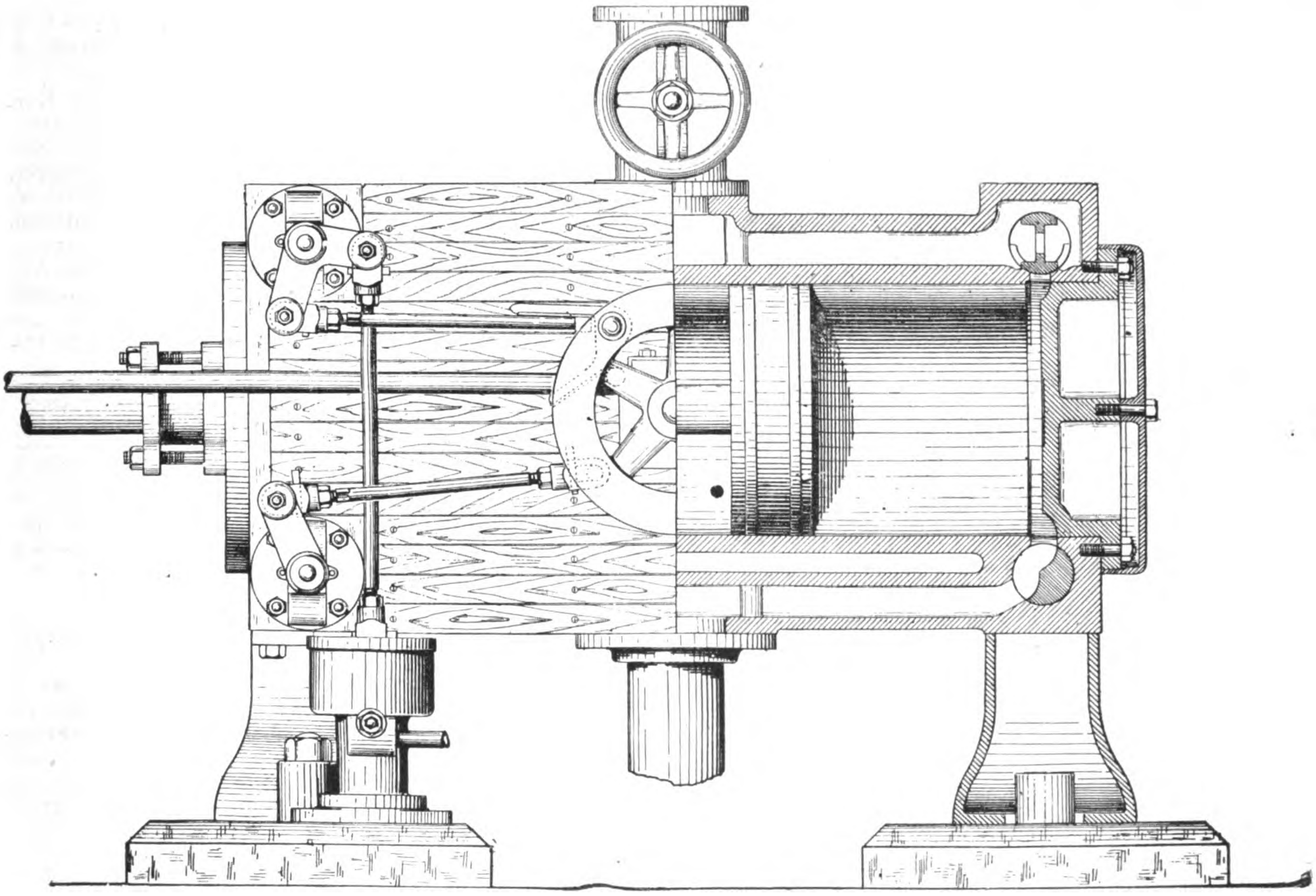


Fig. 3.—THE BATES CORLISS ENGINE.

The engine is built by the Bates Machine Co., Joliet, Ill.

TESTING A LATHE.

Testing a lathe for perfect alignment of live and dead centers, is a rick that not every mechanic is master of, but the methods are, as used in ractice, exceedingly simple. It is impossible to bring the spindles into erfect line by merely bringing them together and then "sighting" the enters both vertically and horizontally. Such a method is the roughest of uess-work, and will answer only for very inferior work. With the machines rdinarily in use in machine shops, a lathe in line with the centers touchng each other, will not be in line when the centers are two feet apart, and f the centers are lined up for that distance, they will not be right for any ther distance apart.

This seems to be giving the lathe a rather bad name for accurate work, ut it is the truth, and it should be remembered that it is not possible to urn a true cylinder between centers, in any lathe yet made. Only by rinding, with the work supported in bearings, can anything approximating true cylinder be formed, therefore, the lathe is not as much to blame as t appears to be.

To test a lathe, then, the first operation is not to put the centers in ine at a distance of from two to ten feet, according to the size of the lathe. Call it a small one, and let the test distance be three feet. Pick out a piece of shafting of this length which is big enough to hang in the lathe without springing—say from two to three inches in diameter. Square up the ends of the piece, centre it nicely, and make sure that the centers are drilled deep enough that they will not bottom. Put a pin in one end of the test piece so that it can be put in the lathe without a dog. Then with a sharp tool, turn a short space as close to the head end of the test-piece as possible, and if the tool can be set right, turn to the very end of the metal.

Then, without moving the tool, take the work from the lathe and turn it end for end. Then run the carriage down to tailstock, put the work back in the lathe with ends reversed, and see if the tool—without being moved latterally—will cut the same as when at work at the other end of the lathe. It must be understood that the tool, when making this test, should be set exactly level with the centers, and not above or below as sometimes operated.

If the tool will continue the cut so that the calipers show no variation in size of the work, then the lathe is in line. If not, the tailstock must be set over until the tool cuts the exact size started at the other end of the lathe.

When the above conditions have been met, remove the tool and put in one with a very fine point and adjust it so that it will stand at the exact middle of the end of the live center. Then run the carriage back, knock out the live center and put a stick three feet long in its place. Whittle down the end of the stick so it can be driven into the seat of the live center, and make the outer end of the stick smooth and square. Then run the carriage up till the tool just scratches the end of the stick. It should make a point in the end of the stick, and will if the lathe is true, otherwise it will describe a small circle. Next, run the tool out of the way and run out the tail-spindle until it touches the stick. If the lathe is true, the center will go into the little hole made by the tool. If out of truth, the direction of the tool-mark from where the tail-center touches, will serve as an indication of how much the lathe is "out," and which way the head-stock must be moved to make things come right. The necessary adjustment must be done by scraping the vees on the under side of the head-stock, so that the latter will be twisted around square with the ways of the lathe. It is usually the case that corners diagonally opposite have to be cut away, and a good deal of care is necessary that the cutting is not done in the wrong place.

The stick used, should be planed true, in some symmetrical form, no matter whether square, round or octagon, but it should be of such a shape that the bending or sagging of the stick from its own weight, will be the same, no matter what side of the stick is uppermost. This would not be the case if a flat stick was used, but with either of the three shapes first mentioned, the bending of the stick will do no harm because it bends from all sides alike, when the different sides are brought uppermost by the turning of the spindle.

Lathe builders have a special rig made for this purpose, consisting of rigid metal bars, or light rods stiffly trussed for use in place of the wooden stick.—[The Tradesman.

Conference of Dunkards.

Agents of the Nickel Plate are authorized to sell excursion tickets to Cedar Rapids, Ia., from May 30th to June 6th, inclusive, at special rate, thus affording its patrons a splendid opportunity to visit their friends in the West.

RULES FOR SHOP WORK.

The following is taken from the new edition of "Loetzer's Hand Book:"

LATHE SCREW CUTTING.

Most all of the modern built lathes are indexed. Which index is figured or found from one Common Number, by which the teeth in each of the gears may be divided exactly, and the additional number of teeth in every next larger gear will be the same as the C. N. (common or convenient number). For example:—If the smallest gear of a lathe is of 24 teeth, the next 28 teeth, the next 32 and so on, then the C. N. is 4. If the teeth increase by 5, then the C. N. is 5. If by 6, then 6, etc.

Lathes that have no C. N. and whose gears are irregular, any number may be used to multiply by, which will then be the C. N. This rule also holds good for lathes that have a C. N. in case a thread is desired to be cut that the index does not show.

The D. S. (driving screw) of a lathe is the next thing of importance that the operator must thoroughly acquaint himself with, to be able to correctly figure threads and gearing for that particular lathe.

In most lathes the true relation of the D. S. to the lathe spindle is maintained. In all such cases the D. S. is correctly represented and figured by the number of its threads per inch.

On a lathe where the true relation of the D. S. is changed by reason of a different sized gear on the feed spindle to that on the lathe spindle, the number of threads per inch on the D. S. does not correctly represent the same, and the correct D. S. must be found, which is done as follows:

Rule—Take two gears of equal size, use one as driver, the other as driven, with any convenient size intermediate gear. Cut a thread, and the number per inch thus found will be the D. S.

This rule is the best test to determine the D. S. of any lathe.

RULE 1.—HOW TO FIND TWO GEARS.

Rule—Take the D. S. as a numerator, and the required threads per inch as denominator; multiply each by the C. N. The new numerator thus found will be the driver, and the new denominator will be the driven. In other words: The result of the multiplying of the D. S. (new numerator) must be placed on the lathe spindle and is the driver.

And the result of the multiplying of the required threads per inch (the new denominator) must be placed on the D. S. and is the driven.

EXAMPLE.

D. S. 4, Threads 8, C. N. 10.

$$\frac{4}{8} \times 10 = \frac{40,}{80,} \quad \begin{matrix}\text{Driver,}\\ \text{Driven.}\end{matrix}$$

Note—This rule is the fundamental principle of all rules for thread cutting.

If a right-hand thread is to be cut, use one intermediate gear. If a left hand thread, use two intermediate gears.

Note 2—When the driver or spindle gear is nonchangeable or assumed, use this rule to find the driven.

Rule—Multiply the number of teeth of the spindle gear or driver by the desired number of threads, then divide that product by the number of threads per inch on the D. S. The result will be the gear to put on the D. S. or the driven.

EXAMPLE.

D. S. 4, Threads 8, Spindle gear or driver, 32.

$8 \times 32 = 256$, then $256 \div 4 = 64$, the driven.

RULE 2.—HOW TO FIND FOUR OR COMPOUND GEARS.

Two gears will cut many plain and many fractional threads, except when very fine or very coarse. To cut very fine thread with two gears, that required on the lathe or feed spindle would be inconveniently small, and that required on the D. S. would be inconveniently large. It would be difficult, if not impossible, to find such small or large gears in the shop.

In all such cases it will be more convenient to use four gears, which will be found as follows:

Rule—First find two gears as shown in rule 1; then find two numbers to multiply together into the driver without a remainder, and two numbers to multiply together in the driven without a remainder; then multiply each of the two numbers so found by any C. N. The result will be the two drivers and the two driven to use.

EXAMPLE.

D. S. 4, Threads 20, C. N. 6.

$$\frac{4}{20} \times 6 = \frac{24}{120}$$

You now have 24 as the driver and 120 as the driven. Take 24 and find two numbers that will multiply together and make the same, as: $4 \times 6 = 24$; then take 120 and do likewise, as: $10 \times 12 = 120$. Then multiply 4 and 6, and 10 and 12 by the C. N. The result will be the two drivers and the two driven to use, and the full example will read as follows:

D. S. 4, Threads 20, C. N. 6.

$$\frac{4}{20} \times 6 = \frac{24\ .\ 4\ .\ 6}{120\ .\ 10\ .\ 12} \times 6 = \frac{24\ .\ 36}{60\ .\ 72} \quad \begin{matrix}\text{drivers.}\\ \text{driven.}\end{matrix}$$

To prove the gears so found use this rule:

Rule—Multiply the first driver 24 by the desired number of threads 20, divide that product by the first driven 60, then multiply that quotient 8 by the second driver 36, and divide that product by the number of threads per inch on the D. S. 4 The result will be the second driven 72.

EXAMPLE.

24 first driver.
20 desired threads.

First driven 60)480(8 quotient.
36 second driver.
8 quotient.

D. S. 4)288(72 second driven.
28
——
8
8

RULE 3.—HOW TO CUT FRACTIONAL THREADS PER INCH.

Fractional threads per inch means: A certain number of whole threads and a fraction of another contained in one inch.

The easiest way to measure fractional threads is as follows: Take any number of threads until they measure even inches, then count the number of threads in that number of inches.

When the pitch of a screw is given in the form of a fraction, as ⅜ pitch, then the bottom figure indicates the number of threads, and the top figure the number of inches. ⅜ pitch would be, one thread in ⅜ of an inch, or 8 threads in 3 inches, or 2⅔ threads per inch.

Rule—Find the number of whole threads in even inches, then find the number of threads on the D. S. in the same number of inches, and multiply by any C. N., same as Rule 1.

For instance, the desired thread is 4½ per inch, and the D. S. is 6 threads per inch. It will in that case be seen that 9 whole threads are found in two inches, and 12 threads in two inches of the D. S.

The example will therefore read as follows:

D. S. 6, Threads 4½, C. N. 4.

$$\begin{matrix}\text{D. S. instead of 6 use } 12\\ \text{Threads `` `` } 4\tfrac{1}{2} \text{ `` } 9\end{matrix} \quad \times 4 = \frac{48 \text{ driver.}}{36 \text{ driven.}}$$

D. S. 4, Threads 3¾, C. N. 6.

$$\begin{matrix}\text{D. S. instead of 4 use } 16\\ \text{Threads `` `` } 3\tfrac{1}{4} \text{ `` } 13\end{matrix} \quad \times 6 = \frac{96 \text{ driver.}}{78 \text{ driven.}}$$

D. S. 4, Threads 11½, C. N. 3.

$$\begin{matrix}\text{D. S. instead of 4 use. } 8\\ \text{Threads `` `` } 11\tfrac{1}{2} \text{ `` } 23\end{matrix} \quad \times 3 = \frac{24 \text{ driver.}}{69 \text{ driven.}}$$

D. S. 4, Threads 2⅓, C. N. 5.

$$\begin{matrix}\text{D. S. instead of 4 use } 12\\ \text{Threads `` `` } 2\tfrac{1}{3} \text{ `` } 7\end{matrix} \quad \times 5 = \frac{60 \text{ driver.}}{35 \text{ driven.}}$$

RULE 4.—HOW TO CUT THREADS PER PITCH.

Rule—Multiply the top figure by the number of threads per inch on the driving screw, use that product as the numerator and the bottom figure as the denominator, then multiply each by the C. N.

EXAMPLE.

D. S. 4, Pitch ⅜ of an inch, C. N. 6.

$$4 \times \frac{3}{8} = \frac{12.}{8} \times 6 = \frac{72 \text{ driver.}}{48 \text{ driven.}}$$

When the pitch is measured by whole inches use this rule:

Rule—Multiply the number of whole inches by the number of threads per inch of the driving screw, and use that product for the numerator, and for the denominator use 1 and proceed as per Rule 1.

EXAMPLE.

D. S. 2, Pitch 3 inches, C. N. 16.

$$3 \times 2 = \frac{6.}{1} \times 16 = \frac{96 \text{ driver.}}{16 \text{ driven.}}$$

When the pitch of a thread is given in one or several whole and part of another inch, as: 1 thread in 2¾ inches, proceed as follows:

Rule—Find the number of even threads in even inches, which will be 4 even threads in 11 inches, then multiply the number of inches (11) containing the even threads by the number of threads in one inch of the driving screw. Use that product as the numerator and the even threads, which is 4, as the denominator.

2¾ pitch we find contains 4 even threads in 11 inches. We find driving screw at 2 threads per inch contains 22 threads in 11 inches, henc the example will read as follows:

EXAMPLE.

D. S. 2, Pitch 2¾ inches, C. N. 5.

$$\begin{matrix}\text{Numerator,} & \text{D. S. use } 22,\\ \text{Denominator,} & \text{Pitch } 2\tfrac{3}{4} \text{ `` } 4\end{matrix} \quad \times 5 = \frac{110 \text{ driver.}}{20 \text{ driven.}}$$

RULE 5.—PITCH OF DRIVING SCREW—HOW TO FIND GEARS FOR SAME.

When the driving screw of a lathe is measured and designated by it pitch, as for instance ⅜ pitch, use the following rule to find the gearin for any desired thread.

As shown above the top figure of the fraction always designates the inch or inches, and the bottom figure always designates the number o whole threads contained in the same; consequently a ⅜ pitch driving screw would have 8 threads in 3″.

Rule—To find the driver simply take the bottom figure of the fraction and multiply the same by the C. N. as Rule 1. To find the driven take the top figure of the fraction and multiply the same first by the desired number of threads to be cut, and then multiply that product by the C. N.

EXAMPLE.

$$\begin{array}{llll} \text{D. S. } \tfrac{3}{8}\text{ pitch,} & \text{Ths. } 6, & & \text{C. N. } 4. \\ 3 \times 6 = 18. & 8, & & 32\text{ driver.} \\ - & \text{Reverse} & \times\ 4 = & — \\ 8 \quad\ = 8, & 18, & & 72\text{ driven.} \end{array}$$

In order to avoid becoming confused in the use of this rule, another way to use the same is as follows: Place the figures of the pitch ahead of the example, following that reverse the same and proceed to figure as per rule. Your example would read like this:

$$\begin{array}{cccccccc} \text{D. S. } \tfrac{3}{8}\text{ pitch,} & & & \text{Ths. } 6, & & & \text{C. N. } 4. \\ 3 & 8 & = & 8 & & & 32\text{ driver.} \\ - & - & & — & \times\ 4 & = & — \\ 8 & 3 \times 6 & = & 18 & & & 72\text{ driven.} \end{array}$$

THE USE OF DOUBLE AND TREBLE THREADS AND HOW TO CUT THE SAME.

Very coarse pitched screws are used for the purpose of raising some piece of work or machinery very quickly where but little power is required. In all such cases the diameter of the screw is not sufficient to have one full standard thread cut on same. The groove will be too deep and wide for the diameter; therefore double and treble threads are cut dividing the coarse groove and the coarse space into smaller grooves and smaller spaces, maintaining a better proportion and better strength of the spindle on which such threads are cut.

When cutting double or treble threads, let the lathe spindle gear be such as will divide evenly into as many parts as threads required, namely: If cutting a double thread, the teeth on the spindle gear must divide evenly in two parts; if treble threads, in three parts, etc.

When the first thread is cut draw a line across the top of an intermediate gear tooth, mark it No. 1 and divide the spindle gear into as many parts as threads required, then take the spindle gear off sufficient to clear the intermediate gear, pull the belt around so that No. 2 will gear into the same place, go ahead and cut the second thread.

When the lathe has a feed spindle gear twice the size of the lathe spindle gear, divide one-half of the gear instead of the whole.

HOW TO TURN TAPERS.

When a piece of work is to be turned taper its full length, and the required amount of taper is given, all that is necessary in that case is to set the tail-stock over to half of the required taper.

But when part of a piece of work only is to be tapered the job is more difficult, and the following rule should be used:

Rule—First reduce the entire length of the job to inches, divide that by the number of inches to be tapered, then multiply the quotient by the amount of taper required and set the tail-stock over to one-half of that.

For instance, we have a piece 4 feet long, desiring 6 inches of same to be turned ⅛ of an inch taper, proceed as follows:

4′ × 12″ = 48″, 48″ divided by 6 goes 8 times; then multiply 8 by ⅛, 8 × ⅛ = 1 whole, or 1″. Then set tail-stock over to ½″.

FULL EXAMPLE.

$$12'' \times 4' = 48''. \qquad \begin{array}{l} 6)48(8 \times \tfrac{1}{8} = 1'. \\ \ \ \ 48 \\ \ \ \ — \end{array}$$

SHRINK-FITS.

The following table of allowances for shrink-fits will be found an excellent guide to bore or turn to, and in all ordinary cases will be found sufficiently correct to give entire satisfaction. In all cases, however, the best of judgment must be employed; and the kind of metal used, its outside diameter or size, its degree of fineness, etc., as well as the facilities for heating and expanding and the labor to be performed by the work when finished must all be taken into consideration and the fit made accordingly.

If a good quality of wrought iron or steel is used a trifle more may sometimes be allowed, whereas if cast iron is used it would not be safe to go beyond these sizes and it may sometimes be necessary to go a trifle less.

Size in Inches.	Amount to Allow.
2″ and under	1-100 or less.
2″-4″	1-100″
4″-6″	1-64″
6″-9″	3-128″
9″-12″	1-32″
12″-18″	3-64″
18″-24″	1-20″
24″-35″	1-18″
35″-45″	1-16″
45″-55″	1-14″
55″-65″	1-12″

A review of this very valuable volume will be found in this issue.

LEARNING TO BE A MECHANIC.

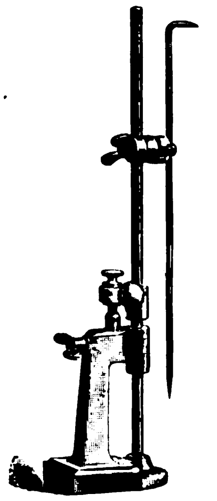
The skill necessary to draw a file straight is not easily acquired. Many a weary half-hour at noonings and early mornings I have spent in practice with a block of cast iron and a testing straight edge; but the trained muscles at last responded to the desire for straight lines and perfect levels, both in draw filing and cross filing.

Pertinacious practice gradually taught how to hit the head of a cold chisel when swinging a hammer from the end of an 18-inch handle. The lesson was thorough, adds the writer in the *Mechanical World*, and was not forgotten after the black and blue bruises on the left hand had disappeared. Indeed, nothing that a man learns by this method of instruction—experience—ever leaves him; it is part of himself. That is one reason why old mechanics, even after they have their physical ability impaired by age, are valuable in the shop.

My apprenticeship in a machine shop was under a good workman but a poor instructor. During the temporary absence of the proprietor the chart for the only screw-cutting lathe was lost. It was on a paper, tacked to a shingle or thin board, and one breezy Summer day was blown out of the window and into the river, on the bank of which the shop stood. It was required to cut some screws in the lathe, eight threads to the inch; the pitch of the leading screw was six threads. Reasoning and thought finally brought about the result that the leading screw should be retarded in its revolutions so that it would travel on its bearing only six-eighths as fast as the blank screws on their centers. Six-eighths is three-fourths; so if a wheel can be put on the spindle of the lathe—the blank screw—that is, three-fourths the power of that on the leading screw, the thing is done. It was already known that an intermediate gear, which was required to drive the blank screw and the leading screw in the same direction, gave only "tooth for tooth," and therefore did not count. An overhaul of the gears was made to find two that bore the relation of six to eight or three to four. Gears relatively with the 45 teeth and 60 teeth would do, these numbers being multiples of 15 by three and four; 60 and 80, multiples of 20 by three and four, would fill the bill, so would the multiples of 30 as 90 and 120. One of these pairs was selected and the screws cut. Never after did the writer care for a lathe chart; given the pitch of the leading screw, and that can be counted by a pocket rule and a collection of gears, and the combination can readily be made.

There is one other item in learning to be a mechanic that the apprentice should know and remember, and that is that the end of his apprenticeship is only the end of his apprenticeship; he has not "learned his trade," as many claim. The mechanic who "knows it all" is not generally worth shop-room. The practice of mechanics, or science, applied to the useful arts, cannot be fully comprehended and appropriated by any man in the period of his mortal life. He is the best mechanic who has never fully learned his trade.

A SIMPLE SURFACE GAUGE.



A new surface gauge has been brought out by E. G. Smith, Columbia, Pa. In his description the following points are noted: The scriber when adjusted is held firmly in its place by tightening the lower thumb nut. The rods are not injured in any way, no matter how tight they are fastened. No springs are used to lower or raise the scriber, but a positive motion is provided by means of a shoulder thumb nut. By putting the scriber between the frame, work can be laid out close to the base. By extending the rod through the base of the gauge it can readily be used as a depth or scratch gauge with screw adjustment. The main rod can quickly be replaced by a longer one, so as to make the gauge almost any size. The upright extensions of the frame will hold the rod stiffer than the ordinary shaped gauges, and at the same time allows the main rod to be extended over four inches. If desired, a straight edge as fastened to one of the square sides of the gauge, so as to use it along the edge of a surface plate, or on the lathe shears, for trueing or laying out work in the lathe.

Mr. Smith is making a specialty of furnishing separate parts of surface gauges, which is certainly an advantage to those who prefer to make their own. Making tools of this kind is the best practice a machinist, especially an apprentice, can have. For further particulars and prices address the manufacturer.

GERMAN engineers are of the opinion that quite a success has been achieved by the recent establishment at Offenbach of a system of pipes for the transmission of power by compressed air, the laying down of the pipes having been commenced about a year ago, and the work being consummated in the face of many difficulties. The total length of pipes thus laid amounted to 7,760 yards, of which 1,702 consisted of pipe one foot in diameter, 1,710 yards of eight inches diameter, and 4,347 yards of four inches diameter. The pipes were laid about one and one-half feet below the footpath, the connections of the pipes being made by means of India rubber, according to the method pursued for similar work in Paris, and valves are provided for shutting off the air from separate lengths of pipe. On the initial trial of the system, made by the engineering authorities of the town and by the Boiler Inspection Association, it appeared that there was a loss amounting to 0.11 of an atmosphere in seven and one-half hours, that is 0.39 of a cubic metre per hour kilometre, a loss equalling 13 per cent. on the daily output, the power transmitted being, on an average, 500 horse-power—a very favorable showing.

A MINE manager in Nevada claims to have invented a gun of remarkably rapid firing capacity, the implement having a Winchester barrel and stock, with a 15-repeating magazine in the stock. It is a trifle heavier than the ordinary Winchester, but its great feature, as claimed, is that the whole fifteen shots may be fired in one second, a statement which has been fully realized in practice. The shells are thrown out, and at the end of the firing the gun is as clean as though only a single cartridge had been exploded. It is stated that an instantaneous photograph was taken of the gun in action, and, while the exposure was made, five shells were in the air tossed out by the inconceivably rapid working of the gun. As described, the weapon is one of extreme simplicity. All that the man who does the shooting has to do is to fill the chamber with cartridges, cock the gun and pull the trigger as many times as he means to shoot.

HAVERFORD STORAGE BATTERY SUB-STATION ELECTRIC LIGHTING SYSTEM.

The Haverford Electric Light Co. was the first corporation organized in this country for central station lighting with storage batteries. Its works are situated at Haverford College, a station on the Pennsylvania railroad, nine miles from Philadelphia. Its main circuits run one mile east through Ardmore, and two and one-half to three miles west, passing through Bryn Mawr and Rosemont, surburban stations on the Pennsylvania railroad, in a section containing many large country residences.

Operations were commenced in May, 1887, but until one year ago no serious effort was made to extend the business and occupy the field. This delay was chiefly due to two reasons: First, because the system was a new one and investors were cautious, and second because of the failure of the underground cables used as charging mains.

About 15 miles of underground cable were laid when the company first commenced business, only a very small portion of which is now in use. The experiment proved costly, and demonstrated that underground construction is not suitable for an electric lighting system in a country district. The reason for this is that the cost of construction and maintenance is entirely too great for the business done, and the underground system is not elastic enough to admit of additions and extensions except at a cost which is prohibitive.

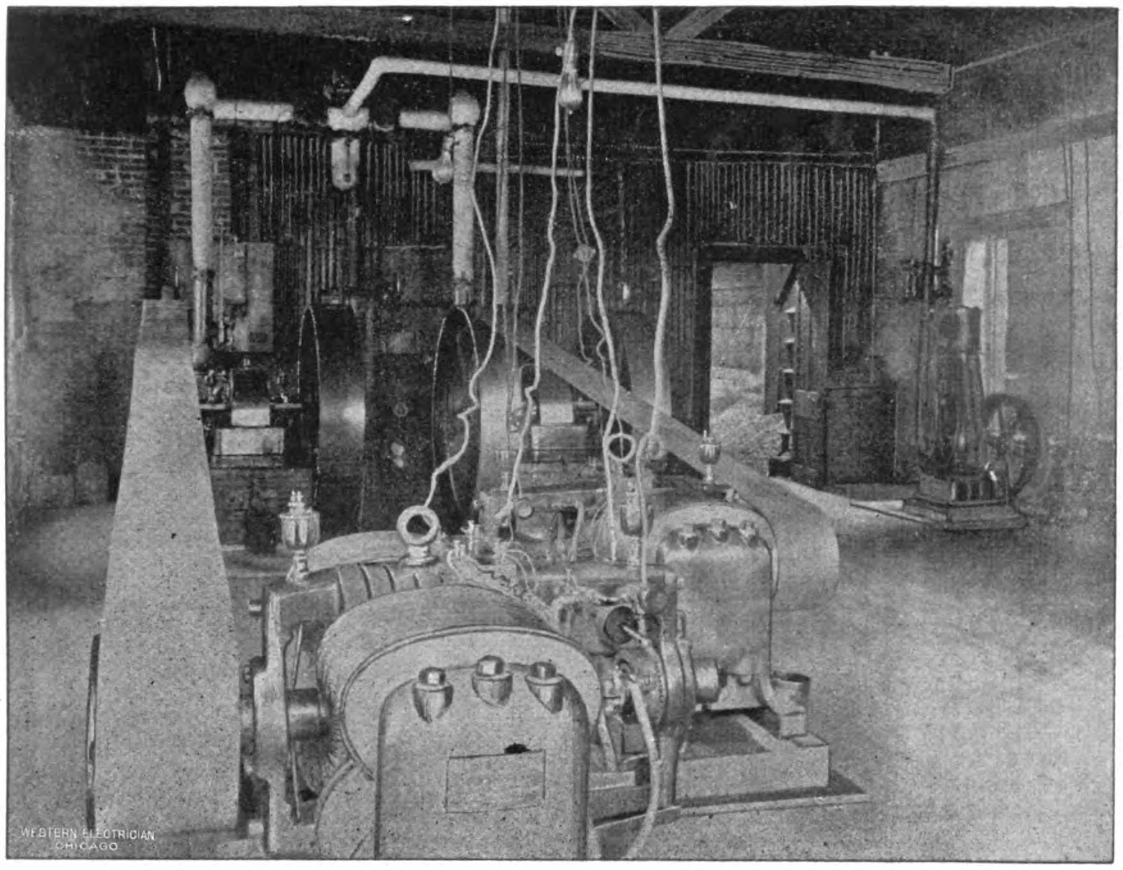


Fig. 1.

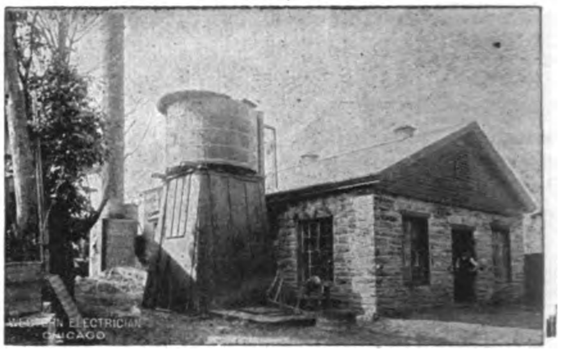


Fig. 2.

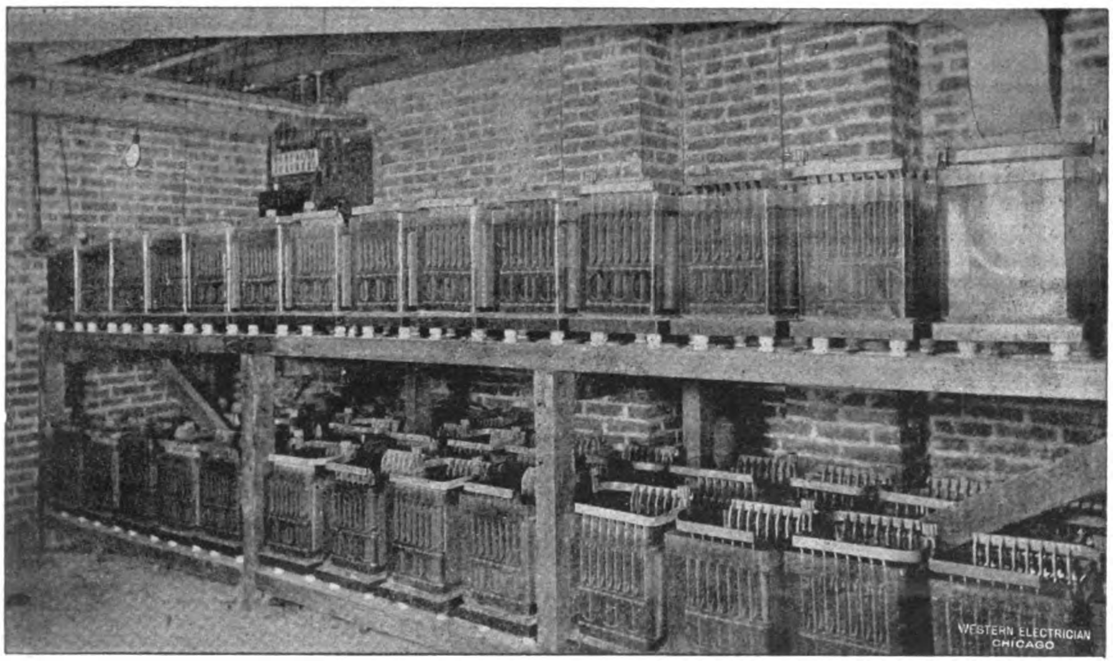


Fig. 3.

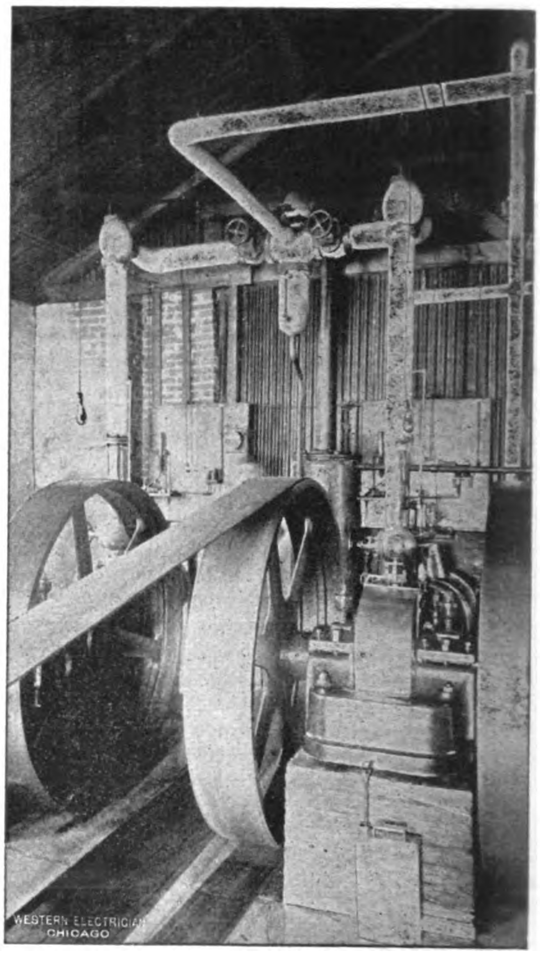


Fig. 4.

HAVERFORD STORAGE BATTERY SUB-STATION ELECTRIC LIGHTING SYSTEM.

During the last year overhead lines have been built to take the place of the underground cables, and supply the new customers who have been secured on the most advantageous routes. This change resulted in great economy, both in the maintenance and running of the plant. The customers of the company are for the most part large consumers of light, and the houses supplied have installed in all about 3,000 16-candle power lamps. The batteries in some cases supply but one house but, as a rule, each battery supplies from three to ten families. The cells are usually located in the basements of the houses and are connected to the charging main in some cases by a non-break hand switch, and in others by an automatic time switch. The batteries are disconnected from the charging circuit by the hand switch or automatic devices operating either at a definite time or when the battery is sufficiently charged, depending upon the character of the consumption. The cells are charged in series. The generating plant is run 10 hours a day, and the batteries are put on and off the different circuits at such times as will give the dynamos an approximately full load at all times. Where a large number of lamps are regularly in service, taking current from the same battery, the cells are connected with the circuit during the whole ten hours of charging. Charging is continued, too, during the hours of heavy lighting. The battery is thus receiving current during the hours of light or no load, and is discharging during the hours of heavy load.

As a battery increases in voltage as it becomes fully charged, an automatic regulator is employed in cases where a battery is to be used at the same time that it is receiving charge, otherwise if but few lights were burning the voltage would be too high for the lamps. The regulating device throws a resistance into the lamp circuit sufficient to overcome the surplus voltage, while the battery is receiving charge. If, however, there are a sufficient number of lamps in service to use the current received from the dynamo, and at the same time make a demand upon the battery, the switch is automatically thrown so as to take out the resistance in the lamp circuit. In cases where the battery is charged in the daytime no voltage regulator is required.

By this system it is possible to supply as much current to a building as the dynamo and battery combined are capable of delivering; in other words, with a 30 ampere charging current and a discharge of 30 amperes from the battery as many as 120 16 candle-power lamps can be burned from one battery. Where a greater supply is required a second battery is installed. With the new types of battery it is entirely practicable to take as high as 100 amperes from a single series of cells without damage to the plates; such a rate of discharge, however would soon exhaust the battery.

Where several small residences requiring only from six to ten houses. It has been found that it is entirely to light from one battery, houses within a radius of from 600 to 800 feet. In such a case as this, though, a regulator is required to keep the voltage constant.

The Haverford Co. lights the three railroad stations situated within its district the lamps burning all night. Two of the company's customers have from 300 to 400 lamps each.

The charge for the light is based upon the current consumed, as indicated by the Edison electrolytic meter. The company first started out by charging a fixed sum per annum for each consumer, based upon the probable consumption. This method proved unsatisfactory in many ways. The customers, as a rule, used the light lavishly, and with little regard to the interest of the company. This arrangement, therefore, was more disastrous to the company than if it had been running a direct system, because, as the batteries were attached to the lamp circuit for the whole 24 hours, they would become exhausted by lamps which were left burning during the whole time, with the result that many battery plates were thus destroyed. The introduction of the new system secured an economical use of the light, and the charge per lamp hour, being less than the cost of an equivalent amount of gas, made the system acceptable to the patrons of the company. Gas costs in the same territory $2 per thousand feet, and this rate, it is believed, is as low as it can be furnished in a country district. The price fixed for the electric light per ampere of current consumed, which varies according to the voltage of the battery from which it is supplied, but which corresponds to a rate of $1.75 per thousand feet for gas.

The experience of customers with both gas and electric light has always been found to be favorable to the latter. At the present time the electric light company is securing many new customers and is putting a large amount of machinery, new batteries, etc., into service.

The Haverford Co. uses the system of the Accumulator Co., which controls the patents for devices used in the Haverford system.

One of the advantages which have been developed by the experience of the Haverford Co. is that well pumps, fan and small motors of all kinds can be satisfactorily run from the battery at any time during the 24 hours. At these country residences water is now pumped by motors taking current from these batteries. This pumping was formerly done by wind-mills, and there is a noticeable disappearance of the latter from that section covered by the storage battery system.

The station equipment, Figs. 1 and 2f for lighting the Haverford district, consists of about 150 horse-power in boilers, two 50 horse-power engines, one 8 horse-power engine for exciting the fields of the dynamos, and one steam pump for the artesian well, in addition to two boiler pumps. The artesian well pump took the place of an electric motor which was destroyed in a fire, three years ago, when the station was struck by lightning. The pump was put in on one's day's notice, and has since remained in service, although a motor would perform the same service as cheaply, and probably with even greater economy.

The engines are run without a governor. The valves are set to admit a sufficient amount of steam to produce a current of 30 amperes in each dynamo at any voltage. The speed of the dynamo, and consequently of the engine, is regulated by the voltage in the main circuit. The dynamo, therefore, governs the speed of the engine, which receives a greater amount of steam from the boiler in proportion to the number of revolutions. The engines are permitted to run up to 300 revolutions per minute, which is a full load for the engine. As batteries are thrown on or off the circuit, the speed of the engine increases or decreases, respectively. The automatic device shown on the wall in Fig. 4 is operated by a magnet in the main circuit, which closes the steam valve whenever, by accident, a break may occur in the main circuit. The action of this device is instantly to shut off steam from the engine. This system has been operated very successfully and with very much less wear and tear of dynamos than when the shunt system was employed and governing was accomplished by the engine; it requires less care, too, on the part of the dynamo tender.

The company uses buckwheat anthracite coal, with natural draught, under one 80 horse-power boiler of the return tubular pattern and two Harrison safety boilers. Water is taken from a well 175 feet deep, and passes through a National heater and a Hoppes purifier before being put into the boilers.

For long-distance incandescent lighting the Haverford system seems to be eminently suited. The ability to supply a large amount of current at a low voltage at a long distance from the station is one of the best features of the system. One of the largest consumers is located at a distance of nearly three miles from the station, and at times there have been burning at this residence as many as 300 lights at full candle power. Fig. 3 shows this sub-station. Another valuable feature claimed for the system is that the economy in the use of current from a storage battery is greatest when the least current is taken from the battery; that is, with a discharge of from one to five amperes there is a loss in electrical energy, as compared with the current required to charge the battery, of not more than 2 or 3 per cent., while with the maximum discharge the loss is estimated at about 30 per cent.

The safety of electric lighting by this system has been demonstrated by an operation of nearly five years. In that time, it is stated, no complaints have been received either of fires or shocks.

The maintenance of the batteries is the question of greatest importance in connection with the economy of the system. The experience of the company, and the many automatic safeguards now used in connection with the system, as well as the rapid improvements in the construction of the battery plates, have made the cost of maintenance very much less than when the company first commenced business. Nevertheless, it is believed that a still greater economy can be secured now that the company is doing its business on a larger scale, and getting a greater amount of service from the batteries installed.

The Haverford system was introduced under the supervision of Superintendent E. A. Scott, of the Electric-Dynamic Co., of Philadelphia, and its present satisfactory opeartion is due, in a large measure, to that gentleman's careful yet energetic management. H. H. Yarnall, present superintendent of the Haverford Co., was engaged in conjunction with Mr. Scott in developing the plant, and is therefore entitled to a share in the credit for having demonstrated to what an extent the storage battery sub-station system could be made successful. The cuts and description of this plant were procured from the *Western Electrician*.

LECTURES BY THE OLD MAN.

Joe, you are growing to be a pretty good foreman and some time in the future when I am trying to get a dividend for some other firm I hope to see you in this position and doing far better than your humble servant. Your prompt action in sending the men home when the boiler played out without wasting time to see what I had to suggest was very commendable. A good general always decides quickly in an emergency and acts as quickly as he decides.

Suppose you catch those four apprentices before they get their overalls off and we will use them to "assist" in lining up some of the shafting on this floor. It will give them a little experience that may come handy to them some day. From the way some of these belts are trying to get off the pulleys I don't think a re-allignment will come amiss and it may show economical results in the boiler room. Well, boys, do you think we can do this job and get it right? Never tried it, but think we can, eh? That is the way to talk; never say you don't know. To begin with, we will start from this line as we know that it is all right from our engineer's report the other day after he set the new engine. Billy, you go over to the corner grocery and get about two hundred feet of real fine, strong fishing line. Jake, you go out in the carpenter shop and get those four plumb bobs in the firm's tool chest, and also bring those trammel points hanging over the bench. Tom, you can get a light hammer and small nails while Clarence sweeps a clean streak under the line shafting on the floor, also sweeping a clean pathway through the center of the shop. Now, two of you drop plumb lines down from each end of this first line, dropping the string down from the side of the shaft and to within one-eighth of an inch of the floor. You other two chaps will stretch about 40 feet of that fishing line directly under the points of those two bobs as tight as you can without breaking, and nail it to the floor, so. This is our base line; the shaft is right, consequently the string is right. Now, we will take the trammels at this clean spot and with the points six feet apart we will strike an arc across the string with one point, using the other point as a center directly on the line of the string. Moving over on the opposite side we strike another arc at right angles to the string and cutting the other arc in two places. Jake, drive a nail at each place in these arcs where they cross. Billy, take one end of some more string and go just beyond that fourth line of shafting and drawing it tight after Clarence has fastened the other end to the nail on the junction of the circles on the opposite side of the base string, you will move it to and fro from east to west until Tom says you have it directly over the nail at the other intersection of the circles. There. You have geometrically bisected a line and erected a perpendicular to it. We will call this last string the vertical. Now, drop the plumb from the second shaft so it will touch the vertical string and bisect it again with the trammels at that point, driving the nails at the points where the area intersect and go through the same operations, stretching strings at right angles to it and the whole length of the shaft. Do the same thing with the third and and fourth line of shafting, also being careful to see that your parallel strings don't touch any obstructions where you have to run them under some of the machines. Throw all the belts from the pulleys so as to relieve the shafting from strains, or more scientifically speaking, stresses; and drop your plumb bobs down from the shaft at as near a point as possible to the hangers, so. How do the points of the bobs show in relation to the string? About an inch and a half away at the west and just on the string at the east end. Well, that shaft is considerably out of its proper sphere in life. It now becomes your duty to loosen all the hangers but the one at the east end and adjust that shaft until all the bobs point directly on the string; then, using the level, to get them straight the other way, you will proceed in the same manner with each one of the others until you have gotten all those on this floor level and parallel when we will remove our base string and the paralells, leaving our vertical string and get a line from it to the second floor and allign the shafting there in the same manner. Tom wants to know how we are going to carry our line up stairs? Oh! just wait until we have practiced our lesson on this floor and thoroughly learned it, then we will take the next chapter.

Having finished our work here we will prepare to go upstairs. Billy, get the brace and a one-inch bit from the carpenter shop and go upstairs. Tom, hold a plumb line against the ceiling at the end of our vertical string, Clarence will do the same thing at the other end, making small points where the string touches the ceiling when the points of the bobs are right over the string on the floor; now drive a long nail through the floor. Jake, you skip upstairs and help Billy see the nails come through. Soon as they appear the boys down here will pull them back, and Clarence will bore two holes where they were. We will pass the plumb strings up through the holes and the boys upstairs will adjust them to the ceiling of the second floor, the string being free in the hole and the points directly over the base string down stairs. Everything just right, boys? All right, now we are upstairs and drawing another base string along the floor just touching those two plumb lines, we are ready to go to work and correct the errors existing in the shafting on this floor.

THE OLD MAN.

Practical Letters.

Lecturing "The Old Man."

EDITOR SCIENTIFIC MACHINIST:

I like the "Lectures by the Old Man" very well, but I think it about time to turn the tables on him. In his last peppery communication he says he "wants all his men to begin the afternoon with clean faces," or words meaning about the same thing. Now, Old Man, I think it is none of your business whether your men wash their faces at noon, or whether they wash them at all. They are not yours for the privilege of dictating in such matters. It may be better for them to wash their faces—in fact, I think it is. But what I object to is the spirit in which it is uttered.

Another thing. When you grumble at a foreman for keeping a man on one machine instead of giving him experience on many machines, be sure that you have supplied this foreman with sufficient men, and of the right kind to enable him to do as you say ought to be done. I guess somebody better begin some letters, "Lectures to the Old Man." I think he needs some.

C. R. BROOK.

For Draughtsmen.

EDITOR SCIENTIFIC MACHINIST:

Some time ago, I found in a paper, the *Engineering News*, the following article on the preparations of blue prints, which I consider worthy of a place in your paper:

F. H. Latimer has found that adding oxalic acid to the ordinary blue print mixture materially lessened the necessary time of exposure. The solutions used were: (1) Ammonio citrate of iron, 120 grains; water, one fluid ounce, to which are added a few drops of strong ammonia solution till the odor is quite perceptible. (2) Potassium ferricyanide, 105 grains; water, one fluid ounce. (3) Saturated solution of oxalio acid. Equal quantities of the first two solutions were mixed together, and to ten parts of this mixture from one to three parts of the oxalic solution are added just before use, with the result that in cloudy weather the solution containing three parts of oxalic acid prints about ten times as quickly as the pure solution. For ordinary purposes, however, it is better not to add more than 20 per cent. of the oxalic acid solutlon, or difficulty will be found in getting the lines to wash white.

R. W. B.

Gauge Testers and Vacuum.

EDITOR SCIENTIFIC MACHINIST:

In the SCIENTIFIC MACHINIST of April 15th, I noticed a letter from M. C. Mac, criticising Mr. Woodward's sixth and seventh papers under the heading, "Hints to Engineers." Taking Mr. Mac at his word (that any writer should be willing to have his work criticised), I will call the reader's attention to Mr. Mac's criticism.

Mr. Mac says, in reference to Mr. Wodward's sixth paper, that the gauge tester he illustrates is both crude and unreliable, and that it would do as a make-shift, if nothing else could be had, and that there were others that ought not to cost as much, taking everything into consideration, besides being satisfactory as well as accurate for any desired pressure.

First, Mr. Mac says it is crude and unreliable. It may look a little crude to some, but it is as reliable as any safety valve. Second, it should not be called a make-shift because it is simple and any engineer can have one. Third, as to cost, Mac's tester would cost at least ten times as much as Woodward's, and any man who has charge of a steam plant who can not, with the aid of a few inches of gas pipe and in a common blacksmith shop, make a tester as described by Woodward, is unworthy the name of engineer and should be classed with the "country cousins," as one brother calls them. On the other hand, it would require a machine shop to construct one that Mr. Mac illustrates, and I doubt if one can be made water-tight without much friction. But Mac says, give the piston a whirl to relieve vertical friction. Now, how does he do that? Is the piston threaded? Query: Which way do you whirl it?

Referring to the seventh paper Mr. Mac says that he cannot see what difference it makes whether there is air in the boiler or not, so long as there is plenty of water, before lighting the fire. Now, I am sure Mr. Woodward will agree with him there, for he does not say that it will. But he does say that by removing the vacuum the engineer can then learn the true level of the water. Any engineer will learn this who has had any experience with a good boiler.

Perhaps Mr. Mac's experience has been with an old leaky boiler that never has any vacuum. A boiler with a glass water indicator that is in good order will show the level of the water, but gauge-cocks will not until the vacuum is removed.

I do not wish to have any controversy with Mr. Mac, but will leave the question with the intelligent readers of the SCIENTIFIC MACHINIST.

J. L. H.

The Foreman.

EDITOR SCIENTIFIC MACHINIST:

The foreman makes the shop. If it is a well-ordered shop, or one in bad order, you may be sure that it corresponds with the foreman. Let me make one exception. When the superintendent does not run the shop himself and uses the foreman as a medium through which to transmit orders. If he does the latter, the foreman occupies only a nominal position and can not be held responsible for a bad state of affairs. But when he is entrusted with the management of the men and work, as he should be, the shop or department over which he presides will be sure to be a counterpart of himself in many ways. When you find a shop in which every one is in everybody's way, and every man seems to be doing the same thing as every other man—when you see these things, just consider them the mirroring of the foreman.

I want to caution new beginners against some evils which have been "written up" in papers frequently, but not too much, for they are to be recalled and resolutions taken to steer clear of them very often. When starting in as foreman, either as a beginner or in a new shop, make up your mind that you will have trouble unless you observe the truth in your dealings with the men. The neglect of veracity will lead to innumerable complications and will make you a failure more quickly than any other fault. No less important is the injunction to avoid drink. In some shops and places it is not difficult to keep clear of it, but there are many towns in which are a set of men who drink as regularly as they eat. They are not "intoxicated" much, but are about one-third full most every day. These men breed mischief, and are to be dealt with carefully. They want a free and easy discipline—or rather, none at all. They are not infrequently absent, and want the foreman to be in a position where he can not punish them. They will study and plot, and plot and study to get him there, too. They will find out where and how he spends his evenings, and if he is in the habit of going to drinking resorts, only a little, they will manage to meet him there, and it is then an easy matter, generally, to get him to take a drink—sometimes more than one. Any success of this sort will be followed up. The foreman may be a very sober man all this time, with no intention either of committing an indiscretion or setting a bad example. But some morning one of his men, with whom he has been convivial, will not appear. He may be hard pushed for proper help, and the man may be on a job that another can not take up. The foreman may be satisfied that this mechanic has been on a spree, and when he turns up it may be very evident that he has, and the foreman will feel mightily like discharging him—a feeling that would soon impel him to that act if there were no considerations of policy to deter him. But he can not do by this man what his duty to the firm and to himself demanded, because it would soon get circulated that the foreman was "out with the boys" every night—a report that must sometimes reach the ears of the employers, and prejudice them against this foreman.

Don't drink with the men. Don't drink at all, but especially not with those under you.

It is a bad habit to swear. Men who use violent language are not respected as much by the men as they would be otherwise.

Don't know it all. You will find that many of the men under you know more about many things than you do, and can teach you. Because you are the executive head of the shop does not imply that you have the most knowledge. You should be intelligent and able to fill your position, but you were put there because it was supposed you understood the handling of men and possessed some executive capacity, not because you were considered to overtop all your men in general mechanical information.

As a matter of fact, the foreman is rarely the best all-around mechanic in the shop. If he is, and has besides the qualifications of a good foreman, he may consider himself a very fortunate person. An ordinarily good mechanic, with a knack for readily mastering difficulties and getting promptly out of close places, quick to make up his mind, and having the discrimination to put the right man at the right work, will make a good foreman. No one can be a good foreman without knowing how to do these latter things.

GEO. C. BARTLETT.

About Algebra.

EDITOR SCIENTIFIC MACHINIST:

Mr. James F. Hobart comes back at me in the issue of the MACHINIST for May 15, and scolds me for not taking readily to algebra. I suppose I *should* understand algebra and study out the way to use it. But it is like the perfect man—every one should be such, but very few are. No doubt all engineers ought to understand the X, Y and Z business, but as a matter of cold fact very few of us do, and we cannot be reached by such a method. I had not read the issue of April 15, in which Mr. Hobart's third paper on "Erecting Steam Plants" was printed, when I wrote the letter printed in the issue of May 1, and to tell the truth I did not expect it would ever show up at all in the SCIENTIFIC MACHINIST. I have noticed that a good many series of mechanical articles that start out on a simple plan, get too high up the ladder for the people who took most interest in their beginning to thoroughly understand. I liked the commencement of this series. It was an interesting subject to me, and I just happened to express myself as I did on account of these facts. If Mr. Hobart will please accept any apology he may think due I will simply repeat what I said in that letter.

If Mr. Hobart is a "greasy engineer" will he please tell me what difference it makes whether an engine runs "over" or "under"? Also what he would do in case his injector broke and could not be replaced by a new one in several days—that is, can he tell whether he can devise some method of feeding the boiler for a couple of days?

J. J. H., Akron, O.

Some Criticisms—Specialists.

EDITOR SCIENTIFIC MACHINIST:

I have read with interest the articles by "The Old Man." His talks are very pertinent to good shop management. I must, however, disagree with him in regard to the question of putting the apprentice boys at every kind of a job in the shop. Now, suppose you have a young man who shows, in about a year, that he is not cut out to be a first-class all around machinist, and by putting him through the same course you would a more capable youth you will simply give him a smattering of knowledge. What is best, to make a "regular machinist" in form, but a good-for-nothing in fact of him, or put him on one machine, say a planer, and keep him till he knows how to run that tool for any one, or any work? I think it is better for the boy and better for the firm to teach him to do at least one thing well if he is not very bright.

I believe in specialists anyhow. I notice Mr. J. J. Sand wants men to know how to fill any emergency, but such men are produced at great sacrifice to themselves and the shops, and it is ten to one that the emergencies they were supposed to be educated to rise up and "fill," will never occur, under the circumstances which, theoretically, would necessitate their presence. In the general run of work they do not often meet such cases.

It seems to me to be comparable to a large standing army in the United States. There is a possibility that it may be needed, but that possibility is too remote to justify the great expense of maintaining a large force to act in the event of the unexpected happening. So, there is a possibility that a machinist may be placed where his wide range of experience only can prevent great loss, but he had better take the chances of such not occurring than to provide himself for any emergency at the price he must pay.

F. J. MEEKER.

The Tool Room,

EDITOR SCIENTIFIC MACHINIST:

The other day I heard a foreman say that he had tried hard to have the firm put in a tool room, but could not get them to do so. The substance of his conversation was that it was a great inconvenience and a considerable loss in money to the shop. He could convert one corner to this use very easily, and only needed some tools and a regular toolmaker. He had convinced them that it would be wise to have the corner partitioned off and a lathe appropriated, but when it came to the man the project struck a rock—the proprietors would not hire a man especially for the purpose. The foreman was a firm believer in having a good thing or none at all, so he let the matter drop rather thân put in an unskilled man. His description of the confusion, loss of time and material resulting from the system in vogue of leaving every man do his own tool repairing impressed me, and I am sure that any manufacturers running a shop without a tool room would have been convinced of the bad judgment of such a way of doing had they heard him.

For myself, I have always insisted on having a properly equipped tool room and a good man for every twelve or fifteen machinists employed. The proportion of toolmakers to machinists depends upon the kind of work, of course, but as shops go, one of the former to fifteen of the latter is about right.

I have heard it recommended to keep an emery grinder in the tool room. This I consider a necessity, and have had one for years. If I employed but one man, I should give him an emery grinder

K. I. B.

Employers vs. Employes.

EDITOR SCIENTIFIC MACHINIST:

Some months ago, I read some articles in your paper by Mr. Fred H. Colvin about the tyranny of shop rules and of foremen. I was much interested the other day in the answer to question 365. I think you are right in warning peaceable men against the mischief-makers, but I also agree with Mr. Colvin, that it is dead wrong to attempt the "blue law" practice in the shops of to-day. I heard a man say yesterday that if the railroad officials took as much pains to beat their employes as the employes do to beat them, there would be literal war. I do not believe it. I have heard railroad presidents express themselves concerning the question of wages in very strong language. One of them said: "If I had control of every railroad system in the country, wouldn't I starve those fellows into submission! They've no business to have more than a dollar and a half a day, the best of them. They don't earn it, and to get more makes them feel too smart." As to what the officials and employes would do to each other if they could, let me say that it would be diamond cut diamond, but I believe there is more humanity and real magnanimity in the employes than in the employers.

We might carry the same to manufacturing business, where many cases would be found to show that men are often imposed upon to the very last limit. I am an advocate of peace, but I like to see consideration for men by employers as well as consideration for employers by men. Having charge of some 200 men, and standing between a corporation on one side and the workmen on the other, I speak from much experience.

V. L. STOCKTON.

THE McGRATH RATCHET DRILL.

The reciprocating movement of the operating handle in either direction is utilized to turn the McGrath ratchet drill. The holder is mounted to rotate in a hollow threaded shaft containing a longitudinally movable spindle, which, at its upper end, rests either directly against the usual angle iron, or a support, fixed to the work, and which also restrains the hollow shaft from rotating. An operating handle is journaled about the drill holder, as shown in Figs. 1 and 2, the handle carrying two oppositely-acting pawls, shown in the sections Figs. 3 and 4, which engage two ratchet-tooth wheels, one of which is fast on the drill holder and the other loose on the hollow shaft. Secured to the ratchet wheels are bevel gears arranged facing each other and engaging with a common intermediate bevel gear loosely mounted on a stud projecting from the hollow shaft. Movement of the operating lever in either direction will cause one or the other of the pawls to engage its ratchet wheel and act to turn the drill holder and drill in the same direction. Threaded upon the hollow shaft is a sleeve which, when rotated about the shaft, will move the shaft longitudinally to feed the drill to its work. In the outer surface of the sleeve are longitudinally cut ratchet teeth which are engaged by a pawl carried by a tube surrounding the sleeve and partially rotated by the reciprocation of the handle. The engagement of the feeding pawl, as the tube is rotated, with the grooves in the sleeve, may be so adjusted as to give any desired feed to the drill.

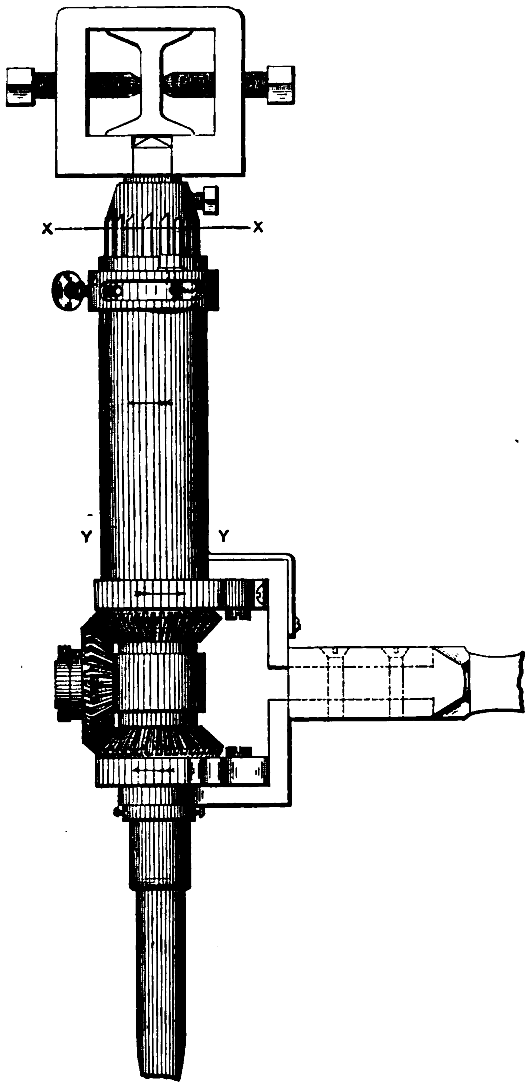


FIG. 1—ELEVATION.

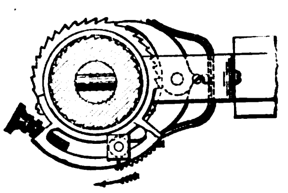


FIG. 3—SECTION ON X X.

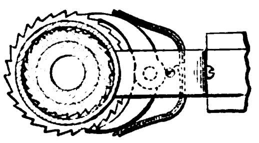


FIG. 4—SECTION ON Y Y.

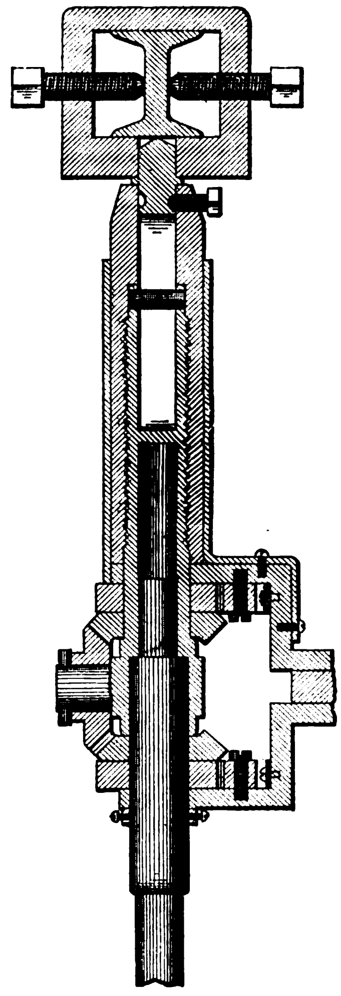


FIG. 2—VERTICAL SECTION.

THE McGRATH RATCHET DRILL.

With this construction there is no lost motion, since the drill is operated at each stroke of the handle. This drill is placed on the market by John F. McGrath, of Taunton, Mass.

THE extensive production of bricks manufactured of coal dust and pitch in France may be judged from the amount stated to have been used in that country in 1889, namely, 24,000,000 tons. The coal dust is for this purpose most thoroughly mixed, in a certain proportion, with melted pitch, and then pressed into shape and afterward dried. Leaving out the cost of the dust and pitch, and bricks cost from 30 to 40 cents per ton to manufacture; the pitch is in value 30 cents per ton of bricks and the coal about $2 per ton, carrying up the figures to some $2.70 per ton. The bricks are formed solid and perforated about 2" long, the solid ones being used on railways and in steamers and in manufacturing establishments, and the perforated ones in houses, the article burning freely and giving but little refuse.

IMPORTANCE OF THE PATENT OFFICE.

The Patent Office is the corner stone of this Nation's prosperity, and the rock upon which our industrial success is founded. Without the labor saving inventions of America by which the productiveness of a man's labor is increased many fold, it would not be possible to pay more for labor and material and still undersell foreign producers, and without our peculiar patent law which requires the government to give something more than a bit of parchment for the fee, and without the patent office with its admirable organization, the inventiveness of the people would have remained dormant and we should have been on the same level with the older nations, struggling in a competition in which the question of wages is the paramount and controlling condition.

With every business of the country directly dependent upon labor saving inventions, and the substitution of power appliances in the place of hand labor, is it not most singular that anybody in the broad land should fail to appreciate the spring of all these waters of gladness? Yet you can hardly pick up a paper without meeting some flippant fling at the patent office. Perhaps this is excusable in a callow reporter, when *learned* M. C.'s say that a yankee can no more help inventing than a hen can help laying eggs, and when the same *learned* gentlemen are incapable of viewing the patent office other than as an asylum for so many needy constituents. But the wonder is just the same, that men with brains enough to enable them to treat some subject sanely, should be so ignorant.

If inventors and others actively interested in patents would unite in an effort to make themselves felt politically, Congress would soon cease to be indifferent. To do this it is not necessary to form any new issues or start any new political party. What is wanted is to make a member of congress feel that he has a demand behind him and a pressure upon him, and he will wake up to his duty fast enough. As it is now, he feels no pressure and hears no demand, and being human he will not unnecessarily add to his cares. If *one* manufacturer in every district would, during the recess, take occasion to impress upon his M. C. a desire which would not take no for, an answer, that said M. C. should inform himself and be prepaired to do something fair for the patent office, the work would be accomplished. It is not because congressmen are indifferent to their duty, but because they are not informed and feel no pressure to become informed. Then also efforts which have been made have universally been made during session. That is not the time either to gain attention or impart information. The average congressman regards the patent office as an unessential and obscure bureau of a not very important department and in presence of the great issues involving political success or the demands of his immediate district, he cannot give it any attention. During recess he has leisure and is face to face with his constituents. He can then be reached, and being reached he will inform *himself*. He does not wish nor need to be attacked with opinions or arguments. What he wants to be shown are *facts*. He will formulate his own arguments. He needs to be shown that no business, even that of farming, could be possible without the use of patented inventions, that it would hardly be possible to compete to-day with the inventions as they were ten years ago and that every invention improves the thing or improves the process of manufacture so as to make it cheaper. If it is made cheaper it is because less material or less labor goes into it: generally it is because less labor goes into it. If less labor, then the productiveness of labor is increased.

No man is compelled to use a patented machine except by the necessity to save money by doing so. And no man *would* buy a patented thing unless he expected to save money by doing so. What, then, becomes of the cry against the extortion of patentees? But the ignorant man says these things would be made anyhow. Would they? Why don't the English, French and Germans make them at home? It is singular that there should be, probably to-day, four times as many applications for patents in the United States than in all the rest of the world, and ten years ago, before several foreign nations had *remodeled their patent laws in the direction of our system*, the proportion was much greater. Since the days of Queen Elizabeth there have not been issued in England more patents than are applied for in a single year in the United States. It is wonderful that when skilled men come to our shores the genius of invention begins to waken. It is not yankee air but the opportunity which creates inventors.

The ignorant man also says with a swell of conscious superiority, "Not one out of a hundred patents is good for anything, or pays expenses anyway." But according to modern system of inductive reasoning we may safely conclude that *this* man is mistaken. When you see a smoke it is not necessary to burn the fingers to know there is fire. Forty thousand men do not put their money into the patent office every year without knowing that there is a fair chance for profit. The great majority know before hand just where the money is coming back from. Their anticipations as to the amount of return may not be satisfied, but there is profit instead of loss to most of them. If it was established that only one per cent. got anything back, the business would certainly be languishing instead of growing steadily larger year by year.

When the congressman has absorbed these *facts* he will not be long in arriving at a conclusion that the patent office is an important institution. He will believe then that the $4,000,000 stored in the Treasury belonging to that office and not to the government, ought to be used to increase the efficiency of that office. He will soon decide that the crowding together like cattle in a pen is not conducive to efficiency. He will conclude that a building erected with money paid in by patentees ought not to be monopolized by other bureaus. He will conclude that the only bureau of government which is now, and always has been, self-sustaining is certainly entitled to the benefit of its earnings, and I hope he will conclude that to fill properly the position of Commissioner of Patents, needs more varied and higher qualifications than are required by any cabinet officer or even by the President in ordinary times; and that that officer, with his bureau, ought not to be an underling in a department of third class importance.

R. D. O. SMITH.

BOOK REVIEWS.

WAYS AND MEANS, for Machinists, Metal-Workers, Model Makers, Watch and Tool Makers, Jewelers, Draughtsmen, Etc. Being a Collection of Hints and Helps Not Found in Books Usually Written for this class of Artisans. By A. H. Cleaves, M. E.; with 125 illustrations. Published by John W. Weston, 78 La Salle St., Chicago, Ill.

This work covers a field hitherto uncovered—or rather, it takes up a class of work that has not been treated of before in mechanical literature. It is not often that the author of a book on practice is himself capable of doing the work he writes about. The author, Mr. Cleaves, evidently knows how to perform all the operations treated of in Ways and Means. The illustrations are very fine. There are ten chapters. The first three are devoted to hardening, tempering and annealing; the fourth to miscellaneous and useful appliances, methods, rules, etc.; the fifth, sixth and seventh to fine work and bench-work, and the eighth, ninth and tenth to bench-work and general machine shop practice, embracing some of the most useful information and finest descriptive cuts we ever became acquainted with. The paper in the book is excellent, the printing clear and easy to read.

The author states that this is the beginning of a series of books from his pen. If all prove as useful in every-day work as this one, a most valuable set will be produced.

STEPHENSON'S ILLUSTRATED PRACTICAL TEST.

This work is written for young men wishing to fit themselves for examination for an engineer's license. It is evidently from an engineer, and will be found helpful to all men running engines. The volume is bound in cloth and is, we understand, sold for $1. The publisher is Walter G. Kraft, 70 La Salle St., Chicago, Ill.

LOETZER'S HAND-BOOK, of Practical Rules and Tables for Machinists. Complete on Lathe Screw Cutting, Turning and Boring Tapers; Figuring Speed. Rules and Tables for Finding Diameters, Circumferences and Areas of Circles; for Computing and Finding the Weights of Round, Square and Flat Iron and Steel, and Cast Iron Pipe and Balls. Rules for Speeding Engines, Emery-wheels, Circular Saws, Etc. Rules for Finding the Required Length of Belts and the Horse-power of Pulleys, Table of Allowances for Shrink-fits, Tables of Decimals of an Inch for Each 1-64th of an Inch and for American and Birmingham Wire Guage Sizes.

It also embraces much practical matter for the engineer. We give elsewhere in this issue extracts from it. The price is 50 cents. C. E. Loetzer, Sayre, Pa., is the author and publisher.

WHY BAND SAWS BREAK. Sixteen Reasons, and How to Avoid Them. Being Instructions to Filers in care of Large Band-saw Blades Used in the Manufacture of Lumber. By Joshua Oldham. Published by M. T. Richardson, 84 and 86 Reade St., New York.

This is a work by one who has had long experience with band saws. It comprises about 100 pages, and is well illustrated. Every sawyer should have a copy. The address of the publisher is given above.

PRACTICAL CARRIAGE BUILDING, comprising numerous short Practical articles upon Carriage and Wagon Woodwork. Plans for Factories; Shop and Bench Tools; Convenient Appliances for Repair Work; Methods of Working; Peculiarities of Bent Timber; Construction of Carriage Parts; Repairing Wheels; Forms of Tenons and Mortises; Together with a variety of useful hints and suggestions. Compiled by M. T. Richardson, editor of the *Blacksmith and Wheelwright*, 84 and 86 Reade St., New York.

This book is quite thoroughly described in the above, from the title-page. It comprises 222 pages, is very well bound, and sells for $1. Every blacksmith and carriage builder or repairer should own a copy.

A MANUAL OF THE STEAM ENGINE. Part II. Design, Construction and Operation. For Engineers and Technical Schools. By Prof. H. R. Thurston, Director of Sibley College, Cornell University.

The first part of this work was fully reviewed some months ago. The book is from the greatest authority on the steam engine in this country, and will be accorded a reception such as his works have ever received. For a description of the two volumes and more detailed information, address, John Wiley & Sons, 53 E. 10th St., New York.

The catalogue recently published by Montgomery & Co., 105 Fulton street, N. Y., which we mentioned in last issue, is eliciting favorable opinions and praise from every quarter. We give below a letter to us from a practical mechanic well acquainted with all kinds of tools and catalogues. It may not be amiss to say that this is a large book of over 700 pages, bound in cloth. It is sent by the publishers to any address, postpaid, for $1.00. The purchase of $10 worth of tools or goods from Montgomery & Co., at any future time, will secure a rebate of the price paid for the book. For instance, if one buys it now, and some time this Summer sends an order of $10 or more to this firm, one dollar will be deducted from the bill, thus making it come free.

This is the letter referred to:

EDITOR SCIENTIFIC MACHINIST: After a thorough examination of the work, I can say, that I know of nothing better that has been published as yet than Montgomery Co.'s new 1892 catalogue, to aid users of tools and supplies of all kinds to make their selections. It contains cuts and descriptions of nearly everything that is needed and of practical use to the mechanic. The different tools and supplies described are so various, as to reach almost everybody connected with the machinist, engineer, jeweler, plating and polishing, and other trades. It does not only give one make or more of the different tools, but includes all the good tools of the different makes, for the purpose for which they are required. In fact anyone can obtain more for their money for this kind of a book than anything yet placed on the market.

Very truly, E. C. LAIR.

NOTES ON SCIENCE.

The peculiar fact is remarked upon in the *Engineering Journal* that, as compared with English practice, the sand blast process has found but little favor in the United States, a single company in Sheffield using at least 200 horse-power of steam in its operations, and the application elsewhere in Europe being extensive for various purposes. In Sheffield the main utilzation in this line is the recutting of new files to improve them. The process is familiar by which files are cut with chisels that raise up shavings or teeth, these being of curved form and with a thin edge that soon crumbles or breaks, unless the cutting is skilfully done and the steel of good quality. When treated by the sand blast, the files are held at an angle, so that the sand impinges on the back of the teeth, cutting away the thin edge, but not affecting the face, the teeth thus becoming strong cutters without the thin curled edge left by the chisels in cutting. The operation is very rapid, requiring but a few seconds, and the value of the files is much increased. Sand, however, in the common sense, is not employed in this process, but a mixture of sandy clay and water thin enough to be circulated by pumps.

In a lecture before the Society of Arts, Boston, some of the drawbacks to the popular use of aluminum were set forth by A. E. Hunt. The pure metal, he said, is softer and weaker than the commercial variety containing 3 to 4 per cent. of impurity, and the tendency of the metal to become coated with a thin film of oxide on exposure to air gives it a dull appearance, and renders it unsuitable for tableware. It loses its tensile strength and much of its rigidity at 400 to 500 degrees F., becomes pasty at 1,000 and melts at 1,300; it does not roll or cast well, and its conductivity for heat and electricity is only about half that of copper, its tensile strength is not greater than that of common cast iron and only about one-third that of structural steel, while its strength in compression is only about one-sixth that of cast iron. Further, a bar of aluminum 1″ square and 4 feet 6″ between its supports deflects two inches with a load of 250 pounds, while a similar bar of cast iron requires double the load to give an equal deflection; the modulus of elasticity in the case of cast aluminum is about 11,000,000, or only about one-half that of cast iron, and one-third that of steel. Its presence in iron is stated to be deleterious, and it is said not to lower the melting point of steel, statements to the contrary notwithstanding.

It appears from a statement in a foreign technical journal that an alloy consisting substantially of 95 per cent. of tin and 5 per cent. of copper may be used with satisfactory effect in connecting metals with glass for electrical and other purposes, hermetically sealing glass tubes, etc. For this purpose the alloy is prepared by pouring the proper proportion of melted copper required into the molten tin, stirring round with the wooden stirrer, casting or granulating, and remelting. It is found to adhere strongly to clean glass surfaces, and has nearly the same coefficient of expansion as glass: it melts at about 360 degrees C., and by alloying it with 0.5 to 1 per cent. of lead or zinc it may be rendered softer or harder, or more or less fusible, according to the requirements in each particular case. In addition to the uses mentioned, the alloy may also be employed for coating metals or wires, imparting to them a silvery appearance.

It is announced that a Welshman has perfected a sewing machine by which the thread is supplied directly from two ordinary spools, and sews through the assistance of a rotary looper; by means of this arrangement the old style shuttle or bobbin is done away with.

A reliable thermometer for high temperatures, as described in the *Philosophical Magazine*, has at last been devised, the instrument being made in the form of a platinum resistance, the simplest shape of which consists of a coil of fine wire welded to leads of comparatively low resistance; the electrical resistance of such a wire varies according to its temperature, so that the reading of the one gives the other by consulting a table prepared with reference to the zero of the instrument. Siemens' well known electrical pyrometer depends upon the same principle, but in this case the zero is known to change largely and continuously—an effect due, it is alleged, to the imperfect design characterizing the Siemens apparatus; the fact being that, if the wire is pure to start with, and is protected while in use from strain and contamination, its resistance, after having once been annealed, is always very near the same at the same temperature. The improvements now announced in the platinum resistance thermometer, or pyrometer, consist in the better protection and treatment of the platinum wire, and this is differently treated according to the heats to which it is to be exposed; for temperatures below 700 degrees, Cent., the leads may be of copper or silver and the tube of hard glass, or, for work below 1,000 degrees, a wrought iron tube may be used.

It is now generally held by electricians that the principle of the aurora borealis is the same as that shown by the Geissler tube, in which electricity is discharged through rarefied air.

A New Supply House.

We are pleased to inform our readers that the J. H. McLain Co., of Canton, O., have just opened a store in this city, at No. 10 So. Water street. Besides having in stock a full line of goods of their own manufacture, consisting of iron and brass goods for steam fitters, engine builders and plumbers, they have made arrangements with the Canton Steam Pump Co. & Akron Heating and Ventilating Co., and are figuring with other parties on engines, boilers and other machinery of which they expect to handle a full line, and carry same in stock, as soon as the new addition to their building is finished, which will give them the largest and finest machinery wareroom in this city. They have just placed on the market the Globe Injector and Canton Lubricator, and a new design of glass oiler, illustrations of which will appear in our paper soon. Any one desiring information or prices on any goods in their line will do well to correspond with or call on them. This branch of the business will be under the management of C. E. McCombs, who has for the past ten years been connected with some of our largest houses here in the same line, and we join with his many other friends in wishing him the success he merits.

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Burlington Route New Service.

A through Pullman sleeping car Chicago to San Francisco is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11.45 A. M., less than four days en route.

Republican National Convention.

The Nickel Plate will sell excursion tickets to Minneapolis for delegates and friends at very low rates and liberal limits. Tickets on sale June 1 to 6.

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is offered by the Nickel Plate as they will sell tickets to Cedar Rapids, Ia., at remarkably low rate from May 30th to June 6th, account the Conference of the German Baptist Brethren.

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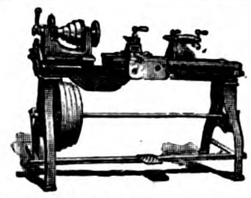

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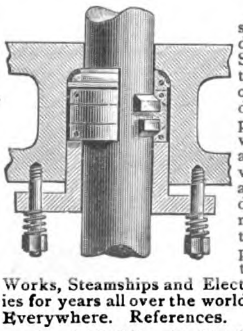

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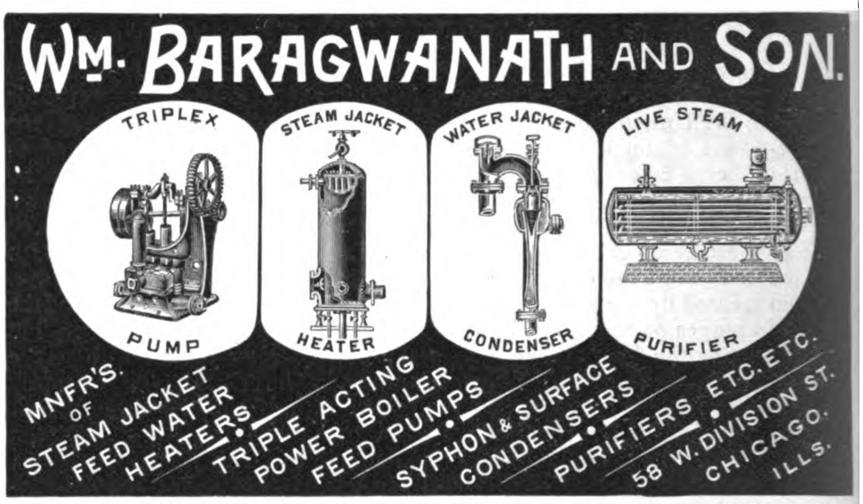

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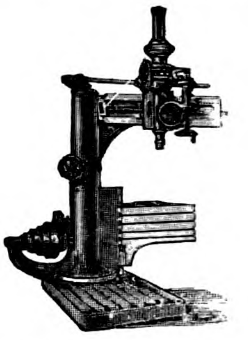

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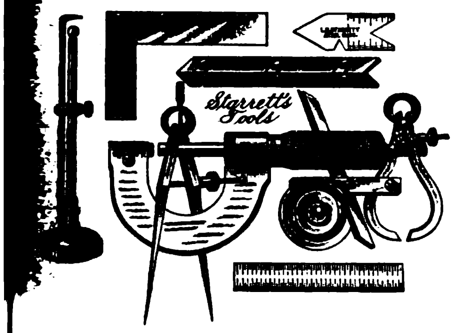

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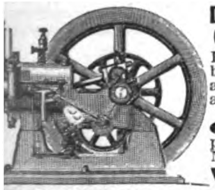

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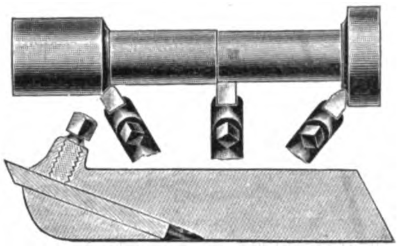

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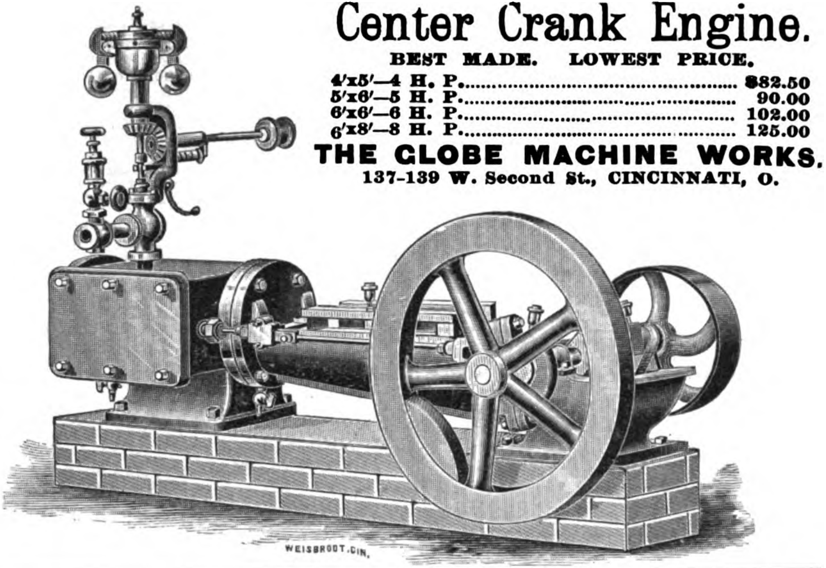
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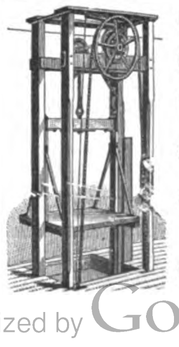

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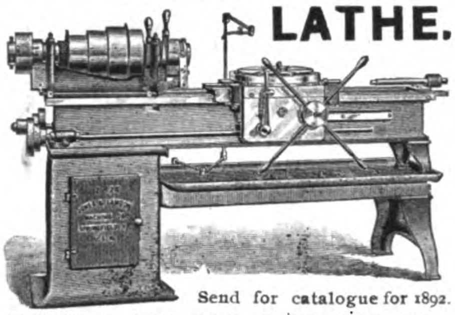

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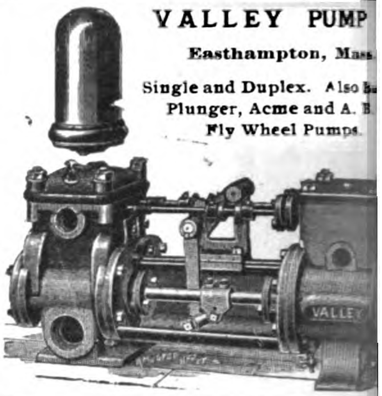

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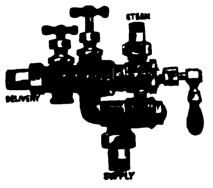

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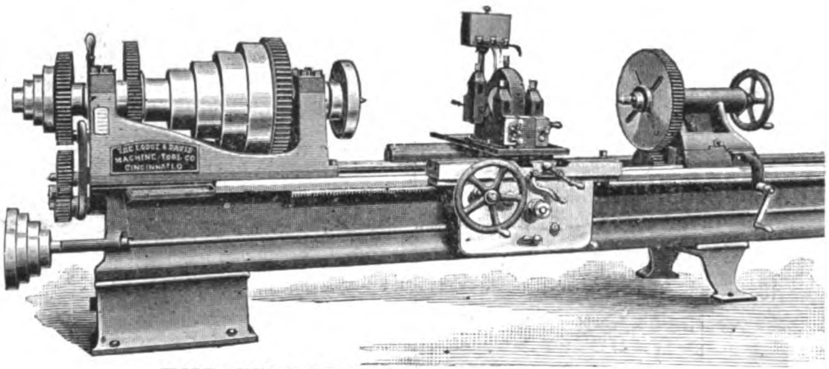
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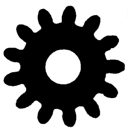

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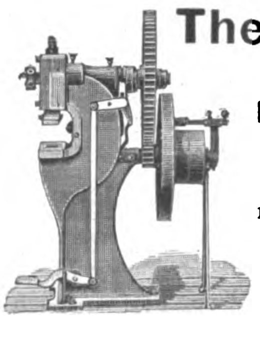

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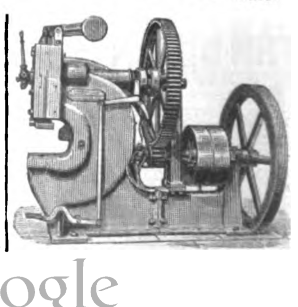
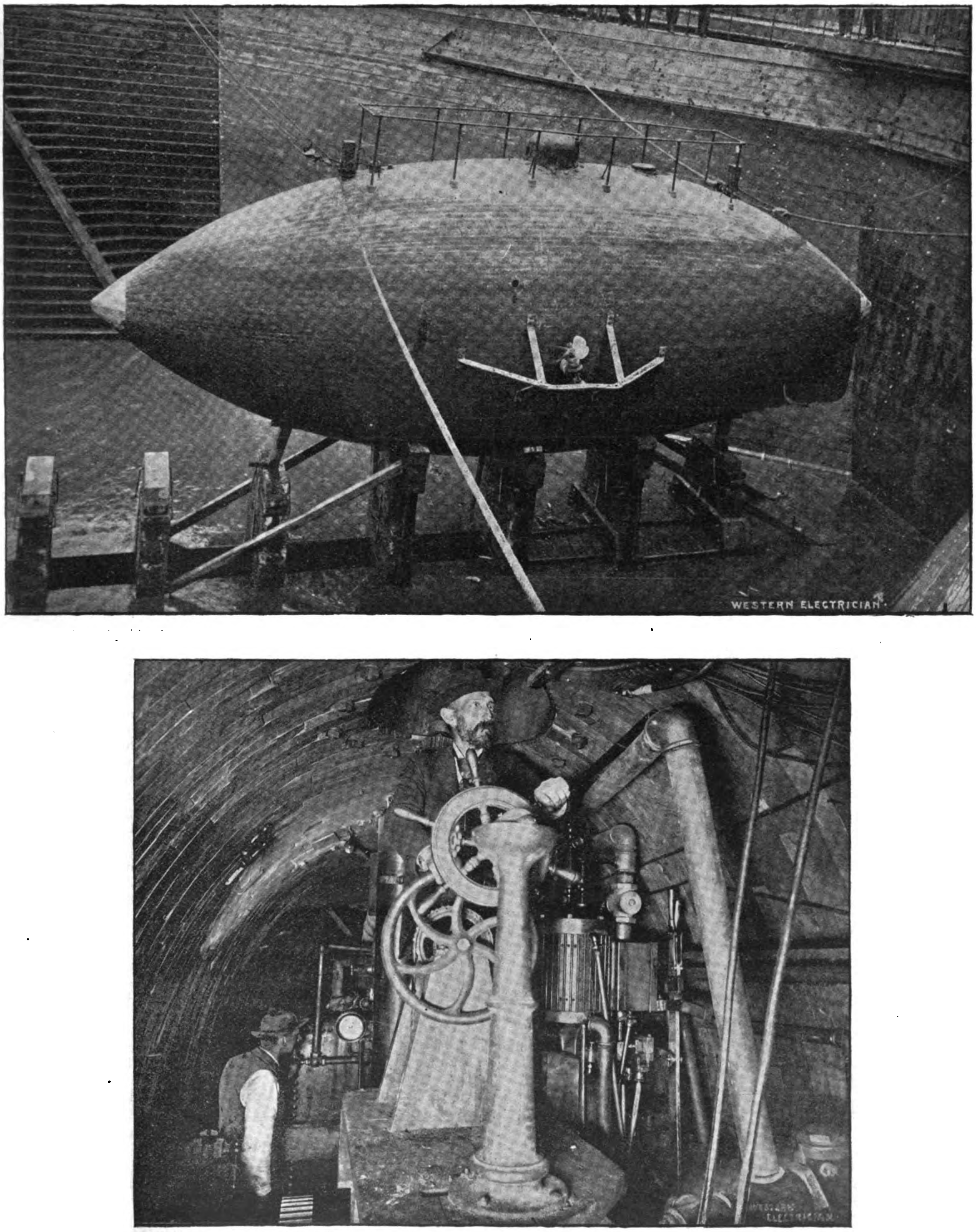


SCIENTIFIC MACHINIST

VOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES

STABLISHED, 1882. CLEVELAND, O., JUNE 15, 1892. Vol. X—No. 12. Published Semi-Monthly. Sold by Newsdealers. Terms:—$1.50 a Year, Single Copies, 7 Cents.



MORE ABOUT THE SUBMARINE BOAT.—(See pages 6 to 8.)

Practical Letters.

A Question in Balancing.

EDITOR SCIENTIFIC MACHINIST:

I would like to ask a little information from some experienced mechanic in regard to balancing in my line of work—fan-blowers and forges. When I have made a fan, having carefully balanced the hub by means of the common parallel level, metal edges, then riveted on the fan blades and again carefully balanced at a standing balance, I find that quite often when the fan is put in place and run at a high speed it will jar or thump considerably and it is quite often very difficult to produce the proper balance to make them run smooth, from the simple fact that on one side the shaft, the hub may have a little extra weight which at a standing balance is equaled by a smaller extra weight at outer end of fan arm, or blade, the difference in speed of the two weights causing the trouble. Now, is there any way whereby I can determine at what points these extra weights are located so this difficulty can be overcome, and so I may know with reasonable accuracy that when such fan is once balanced it will run?

H. L. CHAPMAN.

A Question in the Measurement of Power.

EDITOR SCIENTIFIC MACHINIST:

The plant of which I am at present in charge has for its motive power several engines and a water wheel. They are connected together, in two instances, in such a manner that we cannot readily tell what each is doing in regard to work, as the load is variable, and, as is well known, where water wheels and steam engines are "hitched" together, regulation is not the very best. We cannot therefore apply the indicator to the engine, and arrive at the power required to drive any particular machine, neither can we obtain it from the wheel, as either might be *leading* at the moment we applied a test to one or the other.

Now, this is what I wish to know: Is there any way by which the power required to drive any particular machine can be accurately measured from the machine itself? If you have not already treated this subject it might be interesting and profitable to many of your readers as well as yours truly,

A. D.

[Correspondence on the above question is solicited from practical readers.—ED.]

Mr. Sand Again—De-Magnetizing a Watch—A Suggestion.

EDITOR SCIENTIFIC MACHINIST:

In your issue of April 1st, Mr. Sand enlightens us regarding the hobbing of the worm as well as the wheel, and if he had stated in his paper that it was a Hindly or "hour-glass" worm it would have been plain, but his explanation is very clear and I for one, thank him for it.

However, the value of this kind of a worm is doubted by some; even so good an authority as George B. Grant, in his last catalogue, writes as follows: "We do not make the Hindly or 'hour-glass' worm gear, for it is very costly and no better than the hobbed gear with common teeth."

While Morse, Williams & Co. are a large firm and have had considerable experience in that line (for elevator work will hardly permit the use of any other gear) I should feel more like pinning my faith to Mr. Grant, for I doubt if there exists a better *practical* "gear man" than he is.

John S. asks about de-magnetizing a watch. As to the time it takes, that will depend upon the extent to which it is magnetized, but the method is quite simple.

We know that a current passing in a certain direction will magnetize an iron or steel bar in a certain direction, but that if we reverse the current it will be megnetized in an opposite direction. Knowing this, all we need to do is to subject the watch to the influence of an alternating current, in which, as the alternations occur so rapidly, the magnetism will be reversed a great number of times per minute and after being subject to the influence of this for a few minutes it will be found to have no permanent magnetism, or at least a very small amount.

A reversing switch can be readily devised for use with a direct current if he has no alternating current to use. Construct it so that it will reverse the direction of the flow of current with every throw of the switch or several times during the throw if you desire.

I surely hope that Mr. J. E. Smith will be able to realize a suitable profit from his invention, providing it proves to be a practical device. At any rate, his ingenuity deserves credit.

If it is a good every-day practical sort of a device, the best place to go with it would be to some of the reliable makers of lathes and planers or similar machinery, and if it proves really good there is hardly one of them that will not pay well for it. There are some, it is true, who will take advantage of every one they can but they are not in the majority, I think, and surely hope not.

At the same time Mr. Smith must not expect to get a fortune for the device even if it prove good, for as the good things in the machine line multiply, the value of each in hard cash seems to decrease.

FRANK H. LYNN.

SELECTING AN ELECTRIC PLANT.

BY FRED HERBERT CALVIN.

Continuing the study of the electric plant, for we know they form an important part of the equipment of any modern factory, the incandescent plant is on the whole the most suitable for a factory of ordinary size, and its use is becoming more and more extended every day, necessitating an advance in the engineering fraternity, for they must understand the machines in order to comply successfully with the demand of the times. There are many places, however, that prefer or require the arc system, and to these this paper will give a little advice and information which should prove valuable.

The same general directions for installing are applicable to both arc and incandescent plants, remembering, however, that more care must be exercised in handling the arc system on account of higher voltage. As these lamps run in series they require a definite amount of electro-motive force (E. M. F.) for each lamp and consequently each additional lamp requires an addition to the E. M. F. just in proportion to the amount required by each lamp. This amount varies from 45 to 50 volts in the standard systems, and for ease of calculating we will assume the latter figure.

It will be seen that this system differs from the incandescent, or, more properly, the multiple arc system, from the fact in the multiple arc, or parallel system, the current must increase with the number of lamps, while with this the current remains the same and the voltage or E. M. F. must increase for each lamp in series. Thus, if we run 20 lamps in the circuit and assume 50 volts for each lamp, we see that it requires 1,000 volts for the circuit and this is to be treated with all due respect. Do not be afraid of any circuit, but do not touch any wire or any part of the dynamo until you are sure you know what it is and whether there is any danger from so doing. Remember that "fools rush in where angels fear to tread" and show your "angelic" spirit by exercising care in handling the apparatus. When it comes to economy, there is no question about the arc being far cheaper than the incandescent lamps, which can be readily seen when we know that you can get from eight to 14 lamps (incandescent) of 16 candle-power from a horse-power at the dynamo, and that the standard arc lamp of 2,000 candle-power consumes, under favorable conditions, about one horse-power. You can figure out anything you choose, and compare the light in return for the power expended, but it shows undoubtedly in favor of the arc light. Still, where you want a small quantity at a place, there is no alternative and the extra power must be expended for the lamp, for it has become a *necessity* and not a *luxury* as it was a few years ago. Remember in all cases that the positive current must go into the upper carbon so as to make that the positive, for the positive carbon burns away into a small crater which reflects the light downward, while the negative carbon burns to a point. The lamps will burn reversed, but not satisfactorily, and as the positive carbon throws the light away from it, this should be on top in order to receive the most benefit from the light. Cases sometimes happen in which the dynamo is reversed, *i. e.*, the polarity of the magnets are reversed and the lamps will in this case burn "upside down." This can be remedied by reversing the connections at the lamps or at the machine, but as soon as convenient the machine should be reversed to its original polarity. This can be done by the aid of another dynamo with little trouble, by sending the current through the coils of the field magnets in the right direction. This can be determined by this simple rule: When looking at the pole of a magnet, if the current flows through the winding of the magnet (around the magnet) in the direction in which the hands of a watch travel, the end we are looking at will be the south pole. Remembering this it will be an easy matter to magnetize it rightly, as in every case we must exercise care in handling such important machinery, but with ordinary care this can be satisfactorily adjusted.

The controller magnets must be carefully adjusted, for these may be compared to the governor of the engine, which must be right to insure its economical running, so it is with the dynamo, and in the case of the arc machine, the regulator or controller must be well taken care of. Directions for each particular kind accompany them, so only general hints can be given here.

At the high voltages necessary in arc lighting the commutators need attention of the most careful kind, and as little sparking as possible should be allowed at the brushes. For this work the carbon brushes are recommended as being easier on the commutator, though of course in the case of the Thomson Houston arc machines, they are not in the race. There is new material for this use that has lately come into favor, and is made of a mixture of graphite with pure paper absolutely free from grit. This makes a fine brush and is highly recommended by numerous electricians.

Next to the regulator there is nothing more important than the switch board, and this demands considerable care in design and operation. The board must be designed for the particular case in question, unless, of course, the company installing the plant has one to meet requirements, but as a rule each case requires special treatment. It must be so designed that the attendant is in no danger of a shock while making connections with any of the circuits, and must also be designed with an eye to safety from fire. This is an important item and includes an investment in good lightning arresters. In the circuit there should by all means be an "ammeter," for if the current is not steady the lamps will not burn steadily, and although the wall controller should regulate the current, and will when properly cared for, still we want to know positively just what current we are generating. It is not good policy to run a boiler with only the water glass to gauge the water in the boiler, but we also want the gauge cocks, so in the same way we want the ammeter as a check on the regulator, as it is not wise to depend upon one instrument too much.

Of course the engineer does not put up the lines for his plant, but he should know whether they are right or not and be able to detect any leaks in the insulation immediately after they occur. These leaks, especially on the arc lights circuits, are what make the system dangerous to those around, for while one leak does little harm, the second leak raises a breeze and

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somebody is apt to get hurt. So if we keep the line free from the first leak, the second will not be apt to appear. It is for this reason that the dynamo should set upon a good firm, as well as a thoroughly insulated base, and for the base to be large enough to prevent a man's touching the machine without standing on the base. For if there is a ground on the line, and the dynamo should by any means get grounded also, the man would make connections between the lines and form part of the circuit, probably to his detriment. The lightning arresters should be placed in each of the main circuits leading to the lamps, and the ground connection should be ample, not less than a No. 4 wire should be used for this. Be sure that the earth wire makes a good "ground." Moist earth is the best and the earth end should be connected to a buried plate of metal, copper or brass preferably, because they do not rust out as iron does.

The mechanism of the lamps should be studied by the man in charge, and he should be acquainted with the action of the arc under varying conditions. The main point to be considered is cleanliness, and this same point can be said to be the leading one in nearly all machinery, whether it be electrical or any other kind.

A small room should be provided for testing the lamps, or else one corner of the dynamo room, and when the lamps fail to give satisfaction they should be tested and the defects corrected. It is unpleasant to look into the burning arc even if provided with smoked glasses, and it is unnecessary to do so. By providing a lens and fastening it in front of the testing frame so as to throw the inverted image of the arc on the wall, and by studying the arc as projected in this manner, the defects can be detected and remedied just as well as though the eyes had been strained, as is usually the case. Save the eyes all you can in every case.

However, do not blame the lamp every time it hisses or flames a little, and as in the case of the engine, "don't monkey with it unnecessarily," for the trouble is very apt to be due to poor carbons or the parts being a little sticky or dirty, thus preventing free action of the mechanism.

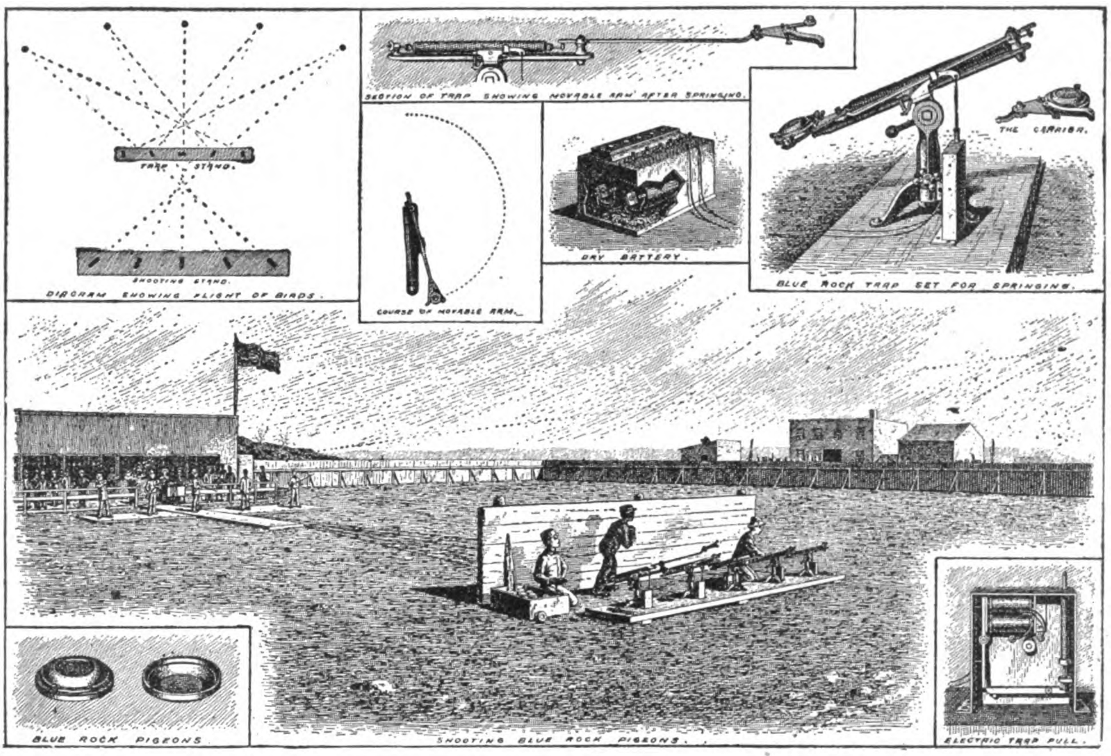
Care and common sense are the two guiding words for all machinery men, and are the principal things to be remembered. A man with common sense is a safer man to put in charge of machinery of any kind, than the man who may have had experience by the yard, but whose bump of common sense is undeveloped. Experience is a good teacher, but without any common sense to go with it, it is not of much account. The man of good judgment is to be preferred every time. The machine should be tested daily for contact or grounds between the circuit and the frame of the machine, and should be immediately repaired in case such a contact should be discovered. Also test the circuit every day for grounds or leaks, and thus prevent the first leak, then the second leak, which is the dangerous one, will not be apt to make you a visit. For this purpose as well as for testing the machine, the magneto bell will be found very handy, although many do not use them on account of the alternating current, which has a peculiarity of sometimes giving a false alarm. In its place is recommended the battery and galvanometer, which is more sensitive and gives no false alarms.

Before the dry batteries came into common use, this form of testing apparatus was rather clumsy, on account of the danger of spilling the acid in handling the batteries from place to place. With the dry battery, there is no danger of their being spilled and as they are light they can be easily handled and will prove very satisfactory. The construction and care of dynamos in more detail, as well as some of the peculiarities and principles that govern the generation of current, will be given at some future time under another series of papers.

The testing and the unvarying care of the dynamos and circuits apply equally to both incandescent and arc circuit. The main thing to be remembered is, that with the increase of electro-motive force or voltage, the insulation and the care of circuits should increase. Just as we increase the strength of the boiler for high pressure of steam, so we should increase the insulation of wire for the higher voltages. In fact, the similarity between the electric machinery, the action of the current and the conduct of steam and boilers, is quite marked. With a few exceptions they are similar and if we only study the action of both, we can understand the action or the electric current all the better. The engineer "who don't want the new fangled ideas" is not the one to advance to a higher position, and the rapid introduction of dynamos makes it only a question of time when the engineer without a dynamo will be a rarity. Wake up, you engineers who are behind the age, or you will be left out in the cold and there will be a new engineer when the dynamo comes in the place.

SPRINGING SHOOTING TRAPS BY ELECTRICIY.

Sportsmen will be interested in the mechanism illustrated in the accompanying cut. Trap shooting is becoming a great sport in this country, but the old way of pulling the traps with ropes is gradually being dropped, and improved electric mechanism substituted in its place. With the old way the ropes would very often get entangled, causing a great deal of delay. With the electric pull the top is sprung instantly as soon as the shooter calls out "Pull!" The traps, according to the *Scientific American*, from which the accompanying cut was reproduced by the *Western Electrician*, are made mostly of cast iron, about one foot in height. The elevation arm containing the trigger, spring and swinging arm with carrier, is about 2½ feet in length. This arm can be placed at almost any elevation, being connected by means of a movable bolt to the circular head of the upright post of the trap, which rests in a ball socket in the base or stand of the trap, and can be turned also at any angle. The spring is of steel, and is 1½" in diameter and about 9" in length, and has a pressure of about 250 pounds.


TRAP STAND.
SHOOTING STAND.
DIAGRAM SHOWING FLIGHT OF BIRDS.
SECTION OF TRAP SHOWING MOVABLE ARM AFTER SPRINGING.
COURSE OF MOVABLE ARM.
DRY BATTERY.
THE CARRIER.
BLUE ROCK TRAP SET FOR SPRINGING.
BLUE ROCK PIGEONS.
SHOOTING BLUE ROCK PIGEONS.
ELECTRIC TRAP PULL.

SPRINGING SHOOTING TRAPS BY ELECTRICITY.

The traps are set and the birds placed in the carriers by boys. The trigger is connected to the electric trap pull by means of a leather strap, which is fastened to a bolt passing down through the top of the battery box, the lower end of the bolt resting on one end of a releasing lever. The other end of the lever passes just under the edge of the lever at the side, which connects with the battery. When the current is on, the top of the side lever draws toward the battery, releasing the bottom lever, and causing the bolt with the spring attachment to drop down, pulling the trigger of the trap with it and letting loose the swinging arm, which throws the bird into the air. The electric pull is connected to a dry battery on the platform behind the shooters' stand, which is about 20 yards from the traps. The shooters and traps are numbered 1, 2, 3, 4, 5. When No. 1 is ready to shoot, he calls out "Pull!" The party in charge of the dry battery touches electric button No. 1, and No. 1 trap throws its bird in the air. Traps No. 1 and 5 throw their birds at an angle of about 30°, traps No. 2 and 4 about 15°, and trap No. 3 straight ahead. Shooters No. 1 and 5 shoot at the birds that fly at the greatest angle. Nos. 2 and 4 shoot at the next angle, and No. 3 straight ahead. The birds will fly about 60 to 70 yards from the traps, and to a height of about 150 feet. The shooters fire at the birds as soon as they show themselves above the wooden screen, before they get too far away. The screen is made of heavy planking, to protect the boys attending the traps from flying shot.

The birds are made of a mixture of clay and coal tar, and are very brittle. The shooting surface, when the bird is in the air, is about 4¼x1½". The birds are 4½" in diameter and 1" in height and ⅛" in thickness. They weigh about 3 ouuces each. The birds are saucer-shaped and fly with the convex side up. The tops of the birds are painted a bright yellow, giving the shooters a spot to aim at before firing.

The carrier is V-shaped, having on one side a raised slot, in which the flange on the bottom of the bird rests. On the other side is a movable arm, with a spring attachment. The bird is held firmly in place by the aid of the spring and the rubber button on the end of the arm. The sudden stoppage after the trap has been sprung forces the bird out of the carrier. The shooters generally use 12 guage shells, loaded with No. 7 trap shot. The traps weigh about 5 pounds each.

SCIENTIFIC MACHINIST

Formerly, WESTERN MACHINIST.

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THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain or brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, JUNE 15, 1892.

☞The Cleveland News Company will supply the trade with the **SCIENTIFIC MACHINIST, through the regular channels of the American News Company.**

SCIENTIFIC MEN WANTED.

The majority of machinists (and to this word we give a broad definition, taking in the men who run engines as well as those who run machine tools) are men of decided taste. They are not money worshipers, but lovers of mechanism. They lack the "all business" faculty which is so ruinous to the cultivation of arts and sciences in the mercantile world; but they are fitted by nature to become artists in mechanical lines. Many of them have as little opportunity to exchange thought with leading machinists as they have to exchange places with fellow workmen in their respective specialties at the lathe or lever.

The specialty machinist must be unfettered and liberated from his narrow cell of monotony. He must be given the freedom of the shop and manufactory in all its numerous phases. Just how soon the ideas of such mechanics as "The Old Man," who is in favor of miscellaneous, practical shop schooling, are likely to meet the approval of the "all business" manufacturer, we cannot say. Probably some of those interesting and valuable "Lectures by the Old Man," which have appeared in our columns of late, have anticipated the age of practical miscellaneous mechanical skill by at least a century. Such thorough practical interchange of knowledge and far-reaching skill must come at the consent of business management and doubtless at the loss of dollars and cents to the shop owner. Therefore a thorough interchange of practice is not likely to occur until our mechanical lovers of art and science shall have become masters of the situation in some manner—probably by the force of the expansion and enlargement of the whole mechanical system.

In the meantime something should be done to give the genuine machinist, who is tied to a special line of work, the next best thing to practical skill in other lines. That next best thing is to be found in a profound theoretical knowledge of the various technical points in all lines of machinery and acquaintance with the right system of construction. We live now by the maxim that a "jack of all trades is master of none." That maxim must die for the sake of broadmindedness. At least we must seek to make a foreman or master mechanic theoretically of every man in the shop, if we would encourage a symmetry of development and a propogation of great men in the mechanical field.

This should make the SCIENTIFIC MACHINIST of great interest to shop owners and manufacturers. An enterprising employer should see that his men are all supplied with scientific reading matter which pertains to their line. That the men themselves should feel the need of this interchange of thought which we afford them goes without saying. We therefore cordially re-invite the hearty good wishes and co-operation of all, both employer and employed, in our work of education.

A MATCH CUTTING machine is an automatic curiosity. It cuts 10,000,000 sticks a day and then arranges them over a vat, where the heads are put on at a surprising rate of speed.

No civilized country prohibits the immigration of skilled workmen.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(375.) I. D., Engineer, writes: "I send you two cards. Will you oblige me by working them out? The diagrams are from a Corliss engine. The cylinder is 12" x 36" and the stroke 30", and 80 revolutions per minute, 50 scale; boiler pressure from 70 to 75 pounds. The engine is non-condensing. The exhaust steam is used for heating the building and for other purposes." *A.*—We scarcely know whether your engine is 30" or 36" stroke by your letter, but assuming it to be 30", the cards figure 29 and 32 H. P.; mean effective pressure 21.5 and 24 pounds, respectively. These are very good cards and show that the valves are well adjusted.

(376.) J. W. Ferry, Amanda, O., writes: "I am running a Griffith & Wedge engine, 18" x 32". On taking the cylinder head off the hind end I found that the rings fail to come to the counterbore by ½", and has worn a heavy shoulder in the cylinder. My predecessor claims that the other end is the same. I claim that it is not right, but he insists that it is. Now you will do me a favor by giving me some information in your next issue." *A.*—You are right. Your piston should travel a little over the counterbore, and if your engine piston has the same distance from each head the counterbore should be lengthened.

(377.) Bert Lechleitner, Seville, O., writes: "I am a reader of your valuable paper and an apprentice in a small machine shop. I noticed your 'Questions and Answers' column, and have so far derived very much knowledge from the same. I would this time like (if convenient) to ask you a few questions, which you may please answer in your next issue. They are at present building a new engine at our shop, cylinder 10"x16", steam ports ⅞"x9", exhaust ports, two in number, 1¼"x9", to run 170 revolutions per minute, and cut off at five 5" or one-third stroke or nearly so. This engine is to take the place of an engine 10"x16", running 90 revolutions per minute, cutting off at 10". It is claimed that the new engine will exert greater power with even smaller consumption of fuel and steam than the old engine. If so, please state how much, and how can you arrive at the saving thereof? The old engine has long steam ports, whereas the new engine's steam ports are at the extreme ends of the cylinder, and has an 'independent' cut-off. Will that be much of a saving?" *A.*—The old engine will develop at 240 piston speed, .571 H. P. per pound M. E. P., and the new one at 475 piston speed 1.058 H. P. per M. E. P. If the old one cuts off at 10", at 80 pounds pressure, the M. E. P. would be 73 pounds, and if the new one cut off at 5", M. E. P. would be 48 pounds. According to the above data, the old one would develop $73 \times .571 = 41.68$ H. P. The new one would develop $48 \times 1.058 = 50.78$ H. P. The ports may be shorter in the new engine, but as it fills the clearance or ports twice as many times as the old one does there will not be much difference as far as this is concerned. And, taking into consideration the additional amount of friction, oil, etc., there will not be a great deal of difference in the engines.

(378.) A. D. J., Ishpeming, Mich., writes: "I have a few questions to ask regarding boilers. I have two boilers, one 18 feet long and 5 feet diameter with 40 4" tubes. The other is 16 feet long and 48" diameter. They are set side by side. The little boiler is 18" lower than the large one. They both feed through the blow-off, that being attached to a flange at center of boilers, or nearly so. Now what I want to learn is, what makes the water go from the big boiler to the little one? I have run them all forenoon without putting the feed on the little boiler, and have three flush gauges of water in the little boiler. How does the water get into it? The engine is a common slide valve. The water goes through to the engine no matter how I carry it in boilers. Now, to make it more clear to you, will give particulars: The engine is running in a saw mill, one boiler fires with wood, the other with sawdsut. On the big one with wood the feed pipe is 3" and the exhaust was a 2½" pipe and I changed it to 4". I want to know how to get dry steam and to prevent the water from passing through from big to little boiler. Remember the engine sets down 4 feet lower than the tops of the boilers. I know how I could do it, but do not know as that would be the quickest way and easiest. I would make the little boiler steam as fast as the big boiler. To stop the water from going to the engine I would raise the engine up about 5 feet. What would you do?" *A.*—Your answer is correct as far as the boiler is concerned. Your small boiler acts as a condenser. The best way to stop water from going to the engine is to put a dry pan under the opening in the steam pipe.

(379.) H. H. B., Buffalo, N. Y., asks: "Please be so kind as t inform me through 'Questions and Answers' column what is the best rul by theory and by practice to get or calculate the horse-power necessary t run any machine with and without the indicator pulley." *A.*—We kno of no way to ascertain this without the indicator.

(380.) E. W. L., Philadelphia, Pa., asks: "Will you inform me through the SCIENTIFIC MACHINIST what size boat a double horizontal engine will drive and at what speed, also horse-power of same? Each cylinder is 4" diameter, 4" stroke and 250 revolutions per minute, and 7 pounds steam in boiler." *A.*—About five or six horse-power, and will ru a boat 25 feet long by five feet beam, six to eight miles an hour.

(381.) L. H. A., So. Wallingford, Vt., writes: "I would like t ask through 'Questions and Answers' what the horse-power of an engin is that has a cylinder 14″ diameter by 3 feet stroke, taking steam nearly the whole length of stroke and making 85 revolutions per minute with 90 pounds steam pressure. It is of common slide valve pattern. Please give explanation and rule, and oblige a reader." *A.*—Your engine is develop-about 2.37 H. P. per pound M. E. P. and if the mean effective pressure is known, that multiplied by 2.37 will give the H. P. See answer to No. 372 in May 15th issue.

(382.) J. S. DeGroff, Burlington, Ks., writes: 1. "Where is the proper place to put the liners on a connection rod of an engine to raise the key, on the stub end or strap end? 2. How is the way to babbitt the quar-er boxes on a main pillow block? 3. How many pounds of soft lump oal does it take to evaporate the water to develop one horse power on an utomatic engine, and how many pounds of water for the same?" *A.*— . Either way will raise the key. Placing on the stub end lengthens the od and placing on strap end shortens the rod. 2. Put clay around the ournal, so the babbitt won't run out. Pour the babbitt same as babbitting ny journal. 3. It would take from five to eight pounds of coal and from o to 35 pounds of water per H. P. per hour. The question in regard to abbitting a shoe on a Corliss engine will be answered later on.

(383.) George E. Mitchell, Boston, Mass., writes: "Kindly inform ne through your paper what amount of radiating surface in feet it requires o heat 100 cubic feet of space in a building of stone, and cut up into ffices, and what amount for large manufacturing rooms? Also, what mount of condensation there is per 100 feet of heating surface per hour, emperature outside about 30°, inside 70°." *A.*—A good authority on his subject says: "If the heating be done by indirect radiation from 50 o 100 per cent. more will be required than when direct radiation is used. o rules can be given which will not require a liberal application of 'the oefficient of common sense.' Radiating surface may be calculated by his rule: Add together the square feet of glass in the windows, the number f cubic feet of air required to be changed per minute, and one-twentieth he surface of external wall and roof, multiply this sum by the difference etween the required temperature of the room and that of the external air t its lowest point, and divide the product by the difference in temperature etween the steam in the pipes and the required temperature of the room. he quotient is the required radiating surface in square feet. Each square oot of radiating surface may be depended upon in average practice to give ut three heat units per hour for each degree of difference in temperature etween the steam inside and the air outside, the range under different onditions being about 50 per cent. above or below that figure. One quare foot radiating surface, with steam at 212°, has been found to heat oo cubic feet of air per hour from zero to 150°, or 300 cubic feet from ero to 100° in the same time.

(384.) Geo. B. Stark, Steubenville, O., asks: "Please give me, if here is any such thing, a rule for finding the area in any circle. The table n the May 15th issue, giving the number of square inches in the face of ny piston from 4″ to 40″ in diameter, is one of the handiest things I ever aw, and enables a mechanic who cannot figure much to tell the power of is engine. Now, please give me a rule for finding the area in square nches of any circle, without going into figures too learned. I understand ddition, subtraction, multiplication and division, also decimals and fractions pretty fair. Can you get up something to meet my understanding? f so you will greatly oblige." *A.*—You can find the area of a circle in quare inches by multiplying the square of the diameter in inches by .7854. o find the square of any number, multiply it by itself. For example, if ou wish to find the area of a circle 44″ in diameter, proceed as follows:

```
                              Square of diameter,  1936
   44                                              .7854
   44                                             ------
  ----                                              7744
   176                                             9680
  176                                             15488
  ----                                           13552
  1936                                          ---------
                       Area in square inches,   1520.5344
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(385.) Buckeye, writes: "What is I. H. P., and M. E. P.?" *A.*— . H. P. is the horse-power as shown by the indicator, which is the actual I. P. This is the only correct way to find it. M. E. P. is the average ressure throughout the stroke, which is also found only by the indicator.

(386.) J. W. R., Lincolnville, Kas., writes: 1. "I have been unning an engine that shakes more than I think it should when running t a good speed, but when running very slow the shaking stops. Now is he counterweight not heavy enough or is it too heavy? I think it is not eavy enough, but I may be wrong. Please give me a simple, reliable ule to find the exact counterweight for any engine. 2. Also tell me here I can obtain an Allen slide valve with a steam port surrounding the xhaust port for the purpose of obtaining two openings for the admission f steam. 3. Please tell me if common unions packed with asbestos will tand the heat in a fire box to connect circulating pipes together." *A.*— ou do not say what kind of an engine it is. It is probable that it is not olid on its bed. If an upright, the cause may be something else. We ould have to know all about the engine before we could tell you what ounterbalance is needed. We do not believe that there is any reliable ule or table from which the counterbalance any engine requires can be igured, unless complicated with so many exceptions and conditions as to e practically useless. 2. Probably some of our readers can give the esidence of the gentleman who puts on Allen slide valves. If any of them now, they are requested to do so. 3. This will depend on the boiler ou have. If the heat is considerable it will not stand.

☞ Readers are cordially invited to send us any questions, comment, nformation, ideas or corrections that suggest themselves while reading the 'Questions and Answers." The time to do it is when it is in mind. If ne puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

A FEW WORDS TO ENGINEERS AND MECHANICS ON LUBRICATION.

The following lecture was delivered by C. Verniaud, M. E., May 16, before the Lyceum of Stationary Engineers, Quincy, Ill.:

I will only dwell at length in this lecture on the subject of lubrication vs. friction and heat, but will pass at once to a few of the general causes involved.

Taking, in the first place, the human or animal frame, we find there is not a joint having either one or both parts moving in contact with each other, that has not a fluid or substance interposed between the two to obviate friction and facilitate motion. This fluid, whether oil or grease, plays the most important part in the life and operation of the joint. Should this lubrication cease, then the action of the joint would cease.

A more forcible illustration of proper lubrication for pressure, speed and durability cannot be obtained.

As to the causes of friction I have, to my satisfaction, after many years of practice and extensive experiments, determined them to be two in number:

1st. When a journal fits so closely into its bearings, or by its weight, that the contact is so close as to expel the lubricant from between the journal and bearings while in motion, it will assuredly cause friction, and this will be followed by heat. Heat will cause expansion of the metal, and the uneven expansion of parts will cause, accordingly, increase of heat; then comes the loss, as above stated.

Engineers and mechanics are well aware that two metallic surfaces can be so fitted that they will of themselves make an impenetrable and perfect joint. Knowing these facts, common sense teaches us that in a journal or joint where a motion is required, the journal should be so adjusted that it will revolve freely and yet without any perceptible play. This will allow the lubricant room to enter between both the journal and the bearing. The lubricant will then form a cushion, avoiding friction and insuring safety and smooth running.

2d. Friction and heat are also accounted for in journals and their bearings from the latter having too much play, as it is generally termed, and the shafting either being out of line or subjected to severe pressure; or by reason of belt strain causing concussion. The surface of both the journal and bearings receiving the full force of the shock will surely become heated if not destroyed. For example, hammering a piece of wire or metal will cause it to heat; try it and feel of it.

Lubrication, if well understood, is the life of a machine. It is an impossibility to run without it, and if proper care and attention be given to good lubrication the highest efficiency and economy will prove to be the results. And in this connection it should be remembered that it is not the quantity of lubricant applied at one time that does the work, but it is the constant application, without waste, of a suitable lubricant that will give the best results.

In regard to waste, it is a positive fact that there are ten barrels of oil wasted where there is one properly used; for in most instances, where the oil can is used, the oil holes or openings on the journal boxes are generally not filled until they run over; and it is not uncommon to see engines where the oil is dipped out of the frame under the crank and also from the fly wheel pit, and the waste oil thrown onto the coal pile, where, on the other hand, if the proper cups and lubricant were employed, the waste and dirt would be entirely done away with.

In regard to materials used in the construction of journals and bearings, it is an admitted fact that both parts should not be of the same metal. Should both be made of the same metal they would grip, as their affinities to each other would be in direct connection and the surfaces of both would soon be destroyed, should no lubrication exist between them. Lubrication is nothing more than the introduction of a suitable body between one or two revolving or sliding parts of a machine, etc., for the sole purpose of forming a cushion between the two to reduce friction. This cushioning is the key to good lubrication.

For example, oil is a good lubricant and makes a good cushion, where the journal or moving parts are not subjected to great weights or strains. But, on the other hand, should the journals or parts be of ponderous weight, and designed to perform work at intervals at each revolution of the journal or under heavy belt strains, then oil oftentimes proves to be too light to form a cushion, as shown by its displacement from between the two. Consequently the cushioning must be in accordance with the work, whether it involves oils, grease or minerals.

Some writers claim that lubrication by oils is due to the molecular action and the small globules of oil, which keep the frictional surface apart, and from a cushion protecting to a certain degree the bearing surfaces from injury. No one will deny that oil as a lubricant will answer and does answer in most places, where pressure, speed and friction are at a minimum, but as oils are easily displaced, the cushioning materially decreases, and in many instances when the flow of oil ceases, hot journals and bearings are the result.

Dry lubrication has also attracted the attention of many mechanics, and many costly experiments have been tried, with but little or no success; and up to the present time experiments and researches are still in progress to solve the problem of dry lubrication by the use of graphite, commonly called plumbago or black lead, which, in its dry state, is a good lubricant—provided it is free from grit. This grit question seems to be the most hurtful as to the article's qualities as a lubricant.

Graphite, plumbago or black lead, when mixed with oils or grease, loses its lubricating qualities and is but little better than lamp black or soot mixed with oil or grease as a lubricant; and when applied in a dry state it accumulates on the journal and bearing, and becomes by friction ground up into a dead black powder that sticks to the journal and bearing, which would, if allowed to run any length of time, ruin both journal and bearing. After graphite has lost its lustre, either by being compounded with oil or grease or by pressure, its lubricating qualities are destroyed.

THE EFFECTS OF SUPERHEATED STEAM IN STEAM ENGINES.

BY FRANK J. ROTH, M. E.

Superheating of steam before its admission reduces the amount of initial condensation, by lessening the quantity of steam needed to give up a specified amount of heat, and this in its turn lessens the subsequent cooling by re-evaporation. That it has a marked advantage in this respect has been especially demonstrated by Hirn. On general thermo-dynamic grounds, superheating is good, because it extends the range of temperature through which the working substance is carried. In modern practice superheating (to any considerable extent) is seldom attempted. It occurs to a small extent whenever dry steam was throttled and a slight superheating is occasioned to steam in its passage from the high pressure to the low pressure cylinder of a compound engine. In former years superheating of steam was a common feature in marine practice, but serious practical difficulties caused engineers to abandon its use and to seek economy rather by increasing the initial pressure, and in using compound expansion. In those days, however, the theoretical advantage of superheating was less understood than it is now. By the use of superheated steam we have such advantages as the so-called caloric or gas engine furnishes. In superheating steam we have no internal work to perform. There is no physical change from the liquid to the gaseous condition by this superheating and consequently no dissipation of heat or conversion of sensible heat into latent heat.

The boilers as a rule furnish wet steam (more or less). The passage of steam through pipes between boiler and engine is another source of condensation due to radiation and the subsequent condensation of steam coming in contact with the cylinder walls and piston furnishes not a small percentage of further deterioration of the quality of steam, the aggregation of which will amount in an ordinary automatic engine to from 20 to 50 per cent. of water entrained in the working substance and in cases even more than that, the greater part of which may entirely be prevented by a judicious superheating of steam before entering the cylinder. Having of late years automatic cylinder lubricators nearly universally adopted and applied, the deteriorating effect of superheated steam may be considered inappreciable. The economy of fuel which its employment would probably secure is so great as to warrant a fresh and energetic attempt to overcome the mechanical difficulty of construction and lubrication that have hitherto stood in the way.

The most important means of preventing cylinder condensation from becoming excessive in the use of compound expansion.

If the vessel or cylinder and pistons were non-conductors of heat it would be from a thermod-ynamic point of view, a matter of indifference whether expansion was completed in a single cylinder or divided between two or more, providing the passage of steam from one to the other was formed without introducing unresisted expansion. But with actual materials the compound system has the important merit that it subjects each cylinder to a greatly reduced range of temperature variation. For this reason the amount initially condensed in the high pressure cylinder is greatly less than if admission were to take place at once into the low pressure cylinders and the whole expansion were to be performed there. Further, the steam which is re-evaporated from the first cylinder during its exhaust does work in the second, and it is only the re-evaporation that occurs during the exhaust from the second cylinder that is absolutely wasteful.

To exact advantages of this division of range as compared with expansion in a single cylinder would be hard to calculate, but it is easy to see in a general way that an advantage is to be anticipated and (though there are isolated instances to the contrary) experience bears out this conclusion. In large engines, working with high pressures, much expansion and slow stroke, the fact that compound engines are, in general, more efficient than single engines, cannot be doubted. Additional evidence to the same effect is furnished when a compound engine is tested first with compound expansion and then as a simple with the same grade of expansion in the large cylinder alone. Thus in the experiments of this country the compound engine of the "Bache," when worked as a simple engine used, 24 pounds of steam (weight) per i. h. p. per hour, as compared with about 20 pounds when the engine worked compound with the same boiler pressure, the same total expansion and steam in the jacket in both cases. The necessity for compounding, if efficiency is to be secured, becomes greater with every increase of boiler pressure. So long as the initial pressure is less than about 100 pounds to the square inch (absolute), it suffices to reduce the range of temperature into two parts by employing two cylinder compound engines; with the higher pressures now common in marine practice triple and even quadruple expansion is being introduced.

The condensation due to the action of the cylinder walls would be greatly reduced if it were practicable to use a non-conducting material as an internal lining to the cylinder and the exposed surface of the piston. No cure for the evils of initial condensation would be so effectual as this and in view of the economy of heat which would result, it is a matter of some surprise that the use of non-conducting lining has not received more serious attention.—[Stationary Engineer.

AN ANTIDOTE FOR MERCURIAL POISONING.

BY LEGH S. POWELL.

Many improvements and novelties are recorded in this and other technical journals. The majority of them naturally relate to contrivances, methods, etc., which are designed to a considerable extent with the object of deriving pecuniary benefit. The case is more rarely met with in which the matter brought forward appertains to progress whereby the cause of humanity alone is sought to be benefited and where pecuniary considerations are wholly absent.

The subject of the present article relates to an improvement, or, more correctly speaking, the institution of a practice of the latter kind, and it is one so effective and easily adopted that it is worthy of extensive notice. It is, moreover, to be hoped that the preventive measure to be described will find its way into the many existing (and future) incandescent lamp factories, and some other industries such in which mercury is extensively employed, in case some equally effective means is not already in force.

Mercury and its compounds are universally known to have an injurious influence on the human system, and the evil effects are, unfortunately, only too familiar to persons intimately connected with the pump rooms of lamp factories. The shake, the shortness of breath, the sickening pallor, the listless, semi-stupefaction of the individual, and other less striking symptoms to which afflicted persons become subject, are sights exceedingly revolting and trying to witness, and cannot but arouse compassion even from the most callous-minded spectator.

Much may be done and much has been done to improve the health of the workmen by means of ventilation and improved machinery and pumps, but it is doubtful whether by such means alone the difficulty can be efficiently and practically met. Slight cases of mercurial poisoning are usually quickly and effectively cured by change of air, or of work, but a serious case may end fatally, as the writer knows. This obvious and effective remedy of change of air, or of work, is not one, however, which always commends itself either to employer or employe as the most convenient course imaginable, and there is, therefore, room for other and more efficient means.

Monsieur Paul Triquet, of the firm of Pulsford, Triquet & Co., Paris (who are extensive manufacturers of incandescent lamps), informs the writer that some three or four years ago he became salivated whilst experimenting with mercury pumps, and he cured himself completely by means of small doses of iodide of potassium, dissolved in milk. M. Triquet next administered similar doses to some workmen in a lamp factory he was then connected with and who were likewise affected with mercury, with the result that they also completely recovered. In his present factory, which has been in full work for considerably over a year, doses of the same salt have been continuously administered to the workmen engaged in the pump room from the commencement, and not a single case of salivation has broken out throughout this period. Further, there have been instances where men from other factories have been taken on, who, on entering, exhibited the characteristic signs of mercurial poisoning, and who completely recovered in due course.

These facts speak for themselves; comment is superfluous.

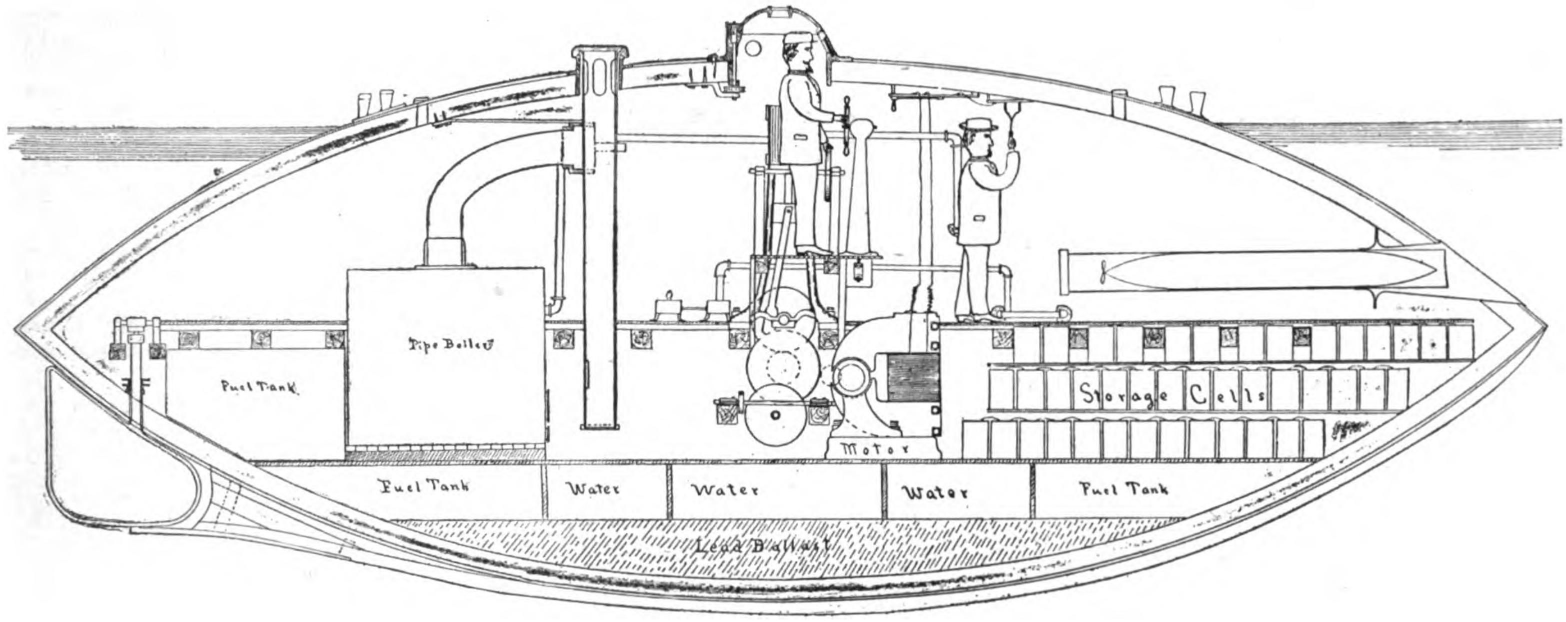
The daily dose supplied by the firm to each man is .25 gramme of the crystalized salt, dissolved in about 400cc of milk. Probably it would be a little more scientific to increase the dose in Summer when cases of salivation are much more frequent, and to diminish it during the cooler months of the year. But this point has little signicance in a case where actual practice fully answers every requirement.

The precise manner in which iodide of potassium acts on the sytem is a problem to be dealt with by medical experts. Generally speaking, however, it is probable that one or more of the iodides of mercury are formed, and that such compound or compounds being appreciably soluble in water, especially in presence of iodide of potassium, become removed from the system in the usual manner.

It is not known to the writer, or to any of those with whom he has spoken on the subject, whether the same or a similar practice to that described is in use in other factories; but, however, this may be, it is certainly not generally known, still less employed. It must be conceded on all sides that very great credit is due to Monsieur Triquet for having originated and put into practice such a simple and effective means of curing and of preventing a distressing malady which accompanies the necessary use of mercury.—[London Electrical Review.

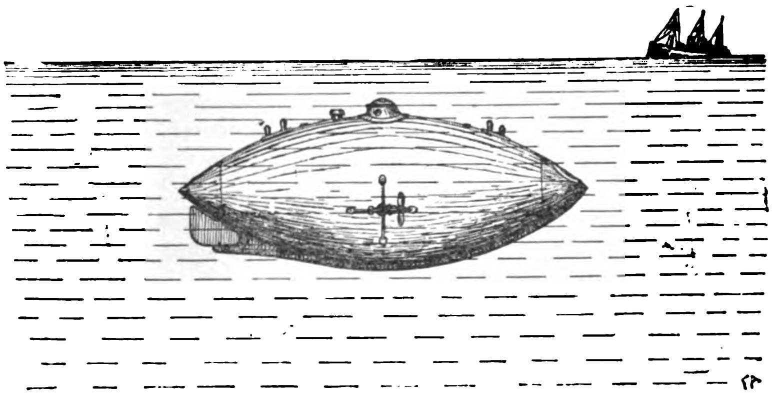
MORE ABOUT THE BAKER SUBMARINE TORPEDO BOAT.

In our May 15 issue we printed a rough sketch and description of the Baker submarine boat, built at Detroit. Since then it has been given many trials, and its success warrants the statement that it is one of the most important achievements of the day. The illustrations here presented show the boat much better than did the cut published May 15th. They were made by, and are used here by permission of, the *Marine Review*. Referring to the means of propulsion—by steam and electricity—that paper says: There is nothing astonishing about this means of propulsion, but the success of the boat lies in the propeller wheels, the arrangement, connection and manipulation of which have been patented by the inventor. There are two 24″ propeller wheels, one on either side, connected with one shaft amidships. To the ends of the shaft are attached gear wheels, working in the gear attached to propellers, which are turned in any position by means of a sleeve around the shaft. This sleeve is connected to a hand-wheel with chain belting. By means of this hand-wheel the propellers may be placed in any position. The propellers are protected by brackets from coming in contact with any obstruction. The rudder fits close to the hull, and the boat answers to it readily. It will be be understood by the foregoing description that such a boat would have no difficulty in running at the surface, but the following description of a descent will explain its submarine capabilities. The boat has 75 tons displacement, the hull weighing 20 tons, the ballast 30 tons, the storage battery cells 10 tons, engine and boiler and gearing 8 tons, and motor 3 tons, leaving 4 tons buoyancy. The normal draft of the boat leaves about 2 feet of the crown of the hull above water. The pilot and electrical engineer enters through a man-hole in the conning tower, and the cover i drawn over and fastened, when the boat is air-tight. If it is considere that the hull contains 1,500 cubic feet of air, a sufficient supply for two men for eighteen hours, the possibility of suffocation is removed. The electrically connected pump is started, and two or three tons of water i pumped into the water bottoms, this additional weight leaving nothing o the boat above the surface except the top of the hull and conning towe To sink directly downward the wheels are turned perpendicular to th shaft, and the motor is started. The amount of spare buoyancy determines the amount of power necessary to sink the boat. When the desired depth is attained, then the propeller wheels are turned at an angle of about 45 degrees, and the boat is propelled forward, neither rising nor sinking, unless the pitch of the wheels is changed. When the commander or pilot wishes to ascend, the machinery is stopped and the reserve buoyancy causes the boat to rise to the surface. Any accident that would stop the machinery would also cause the boat to ascend. The storage battery plant contains enough power to run the boat three hours at a speed of eight miles an hour. The stability and capability of the boat to withstand heavy weather is unquestionable, but if it is desired to avoid a heavy storm, it is only necessary to submerge the boat, ascending for fresh air occasionally. It presents great possibilities in naval warfare. Their construction will not cost so much but that harbors of importance may be supplied with a small fleet of them. In case the fleet of an enemy should appear before some city unprotected from the sea, these torpedo boats could be sent out within a mile or two of the fleet, and, after being submerged, move unobserved to within a few hundred feet of the enemy, and launch a torpedo that would propel itself to the object of destruction. In addition to coast defense work, each cruiser could carry one or two on deck, or, for better protection, in the hold. If the other fleet was found at anchor the submarine boats could be launched, do their work, and save lives and powder by preventing the impending combat.



SECTIONAL VIEW OF BOAT IN MOTION.

The power and capabilities of the boat have been told, and while the experiments thus far have been made under limited conditions, the inventor has no objections to the actual performances being given. The boat has been repeatedly worked in the River Rouge, near Detroit, both on and under the surface, in water from fifteen to twenty feet deep. This has been done simply to test the working of the machinery and becoming familiar with the action of the boat. More recently the boat has been worked in the Detroit river, with a depth of about forty feet, a strong current and with many boats passing, making it a very difficult place to operate such a craft.



VIEW OF BOAT ENTIRELY SUBMERGED.

The conning tower cover was closed over the two occupants, Mr. Baker and Mr. Goddard, at ten minutes to 2 o'clock P. M., and remained closed until 4:35, two hours and forty-five minutes, in which time no unpleasant atmospheric effect was noticed. When the boat was opened, the air seemed as fresh and invigorating as when at first closed. During this trial the boat was repeatedly submerged, disappearing entirely from sight and leaving no disturbance on the surface to note the location of the submerged craft. The boat retained its even keel beneath the surface, and answered readily in rising and lowering to the requirements of the pilot. Altogether, the tests so far have been very satisfactory, and will be continued from time to time until the full capacity of the boat is developed. If the boat continues to develop, as it now promises, it will be heard of in naval warfare.

Since the first test, others have been made. A representative of the *Western Electrician* accompanied the crew on a cruise under water, and relates his experience as follows:

When on Thursday, May 19, the writer, in company with Mr. Baker, for the first time visited Boston's wharf, the temporary charging equipment was in operation charging the cells in the craft. On rounding the boat house a glimpse of the vessel as it lay tied to the wharf was obtained. One's first impression is that the boat is quite small, but this may be accounted for by the fact that so little of the hull appears above the surface of the water. On boarding the craft, though, there soon comes a realization that one is treading the boards of a pretty solid structure and one with a by no means contracted cabin or hold.

All day Thursday was devoted to charging and putting the machinery in first-class order. Friday morning the sun was shining brightly, but the wind was blowing such a gale that Mr. Baker, for reasons already explained, almost decided not to start out into the rough waters of the Detroit river. On returning to the boat at 3 P. M., however, the weather had moderated considerably, and Mr. Baker expressed his belief that before the afternoon was over he would be able to make at least a short trip. After waiting more than an hour for the arrival of H. H. Humphrey, agent for C. D. Jenney, of Fort Wayne, who had sold and installed the motor and batteries and who was to be present at the trial, it was decided to make ready to cast off. Steam was gotten up in Mr. Boston's launch, the Thos. McGraw, and at 23 minutes of five the ropes were untied and the swift current swung the vessel around into the middle of the Rouge river.

The Rouge river is quite a narrow stream that empties into the Detroit river at Delray and the average depth of the water is about 16 feet, with a narrow channel to the Detroit river. The distance from Boston's boat house to a point at which the Rouge meets the Detroit river is about a quarter of a mile, the stream curving slightly, Boston's boat house had been chosen by Mr. Baker as a dock on account of its offering him the advantage of more or less seclusion in which to carry on his experiments.

There was quite a crowd of spectators on the boat house wharf when the vessel was cast loose from her moorings, and on the deck of the craft were Messrs. Baker, Goddard, Rowe, Humphrey and the representative of the *Western Electrician*. As soon as a photograph of the boat had been taken, Mr. Baker and Mr. Goddard went below and Mr. Rowe pulled away. Mr. Humphrey remained on deck until the mouth of the river was reached, and he then boarded the launch to be on hand to render any assistance should an accident occur.

Attention should be called here to the fact that the first trip was made with only Mr. Baker and Mr. Goddard in the boat, and with a float attached to the craft to indicate its position to those on the surface. In the present instance, though, no float was attached to the vessel, and it was for this reason that Mr. Baker decided it would be wise to be not too sanguine, but to take the precaution of having a responsible man like Mr. Humphrey in a launch on the surface where he might watch the maneuvers of the submarine boat.

Before boarding the launch it was agreed between Mr. Baker and Mr. Humphrey that a white card or a handkerchief shown at one of the windows in the side of the turret was to be the signal for help or a tow.

At this time, 4:48 P. M., the sun was shining brightly, with a few flying clouds, and the weather had so moderated that the surface of the Detroit river, although not calm, was by no means turbulent.

At 4 51 P. M. the writer left the deck and went down into the boat along with Messrs. Baker and Goddard. At 4.52, with the final injunction to Mr. Humphrey to "Look out for the white signal," Mr. Baker lowered the turret cap, screwing it down tightly, at the same giving the order to Goddard to "Let in a little more water."

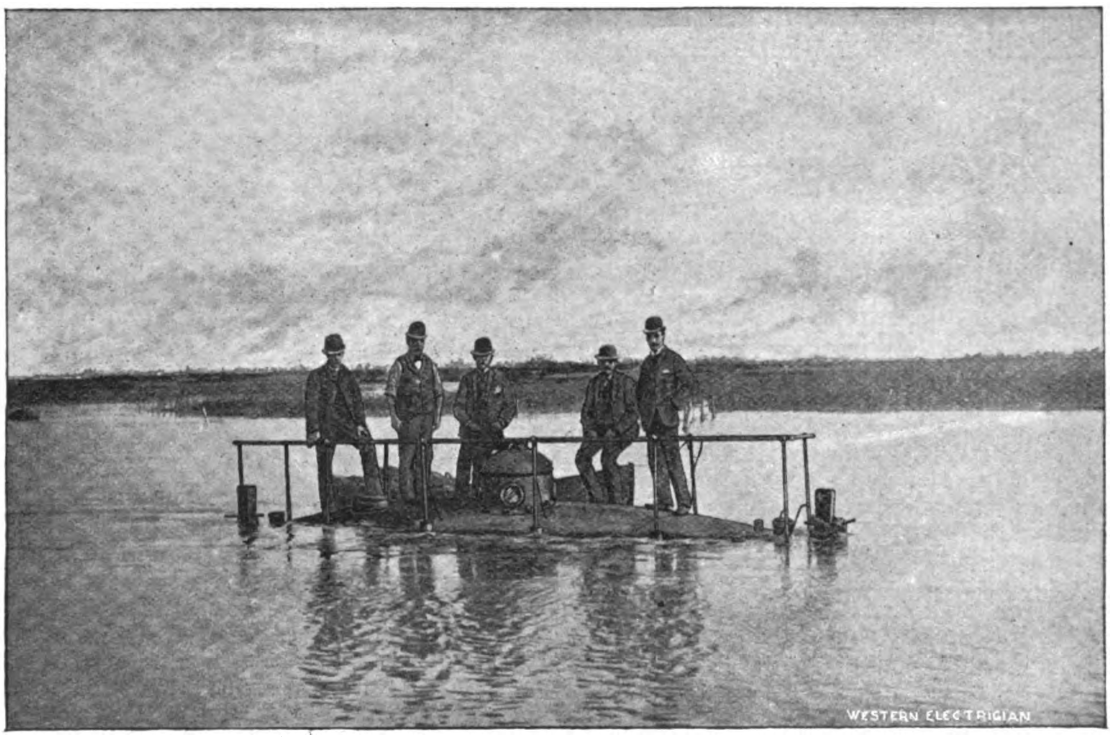
With the lowering of the cap the solitary passenger took a last look at the outer and upper world, and with lungs filled by a final gulp of fresh air, settled himself down at the feet of the pilot. Thus began an experience which, although, as it proved, not made up of thrilling or startling incidents, was nevertheless exceedingly novel and highly interesting. It is no trick, of course, to crouch in the hole of a submarine boat while it is being manipulated by others, but had the writer known that he was to be the first passenger, outside of the crew of two, that would make the trip in the submarine boat in the rough Detroit river—and without the float, too—perhaps he would have done more thinking and indulged in but little observation of the surroundings. But of all this he was at the time blissfully ignorant.

After closing the turret Mr. Baker was occupied in getting the vessel under control. For a few moments sharp commands were given and remarks passed which gave the two men in the hold some idea of what was going on outside and how the boat was acting.

"Let in more water, Goddard." "There she comes." "Hold on a minute, we may be drifting into shallow water; pull her back!" etc., etc. Such sharp orders as these, accompanied by the rapid bell signals to Goddard at the motor switches, not to mention the deafening whir of the gearing, were calculated to obliterate any idea of personal danger, and left but one thought, and that was that, so far, a trip in a submarine boat wasn't such a bad thing after all.

There was not much thinking done, though, for in a moment a quick touch on the shoulder, from Goddard, drew the writer's attention to the little round windows in the side of the turret. Since the closing of the turret lid, Mr. Baker had been gradually reducing the buoyancy of the boat by admitting water ballast to the reservoirs at the keel. The vessel had been settling farther and farther under the water, and at Goddard's signal the water line was at the center of the porthole window. By squeezing one's head and shoulders into the turret, a peep at the outside world was obtained through the moisure-coated glass. The eye was exactly at a level with the crest of the waves which beat against the windows, permitting only occasional glimpses of the shore and the small craft that crossed the vessel's track.

The outside world, however, was of little interest at such a time. The writer's crowning ambition was to go under water—to be completely submerged, in fact, and he had not long to wait before the order came to shut off the water. It required two or three careful manipulations of the water valve by Goddard before Mr. Baker felt that the buoyancy had been sufficiently reduced, and then, at 5 P. M., with the vessel running at its slowest speed and in the swift current of the river came the order: "Now pull ahead, Goddard—give it to her, Goddard!" The motor did its work well, but the buoyancy had to be regulated to a still greater nicety. It was now 5:02 P. M. Two minutes only had elapsed, and now the fishermen and photographer could be seen on the pier at the junction of the two rivers.



ON THE SURFACE.

"A little more water, Goddard," was the last order, and this time, at just seven minutes after five, with the screw running at full speed, the writer, looking up through the window in the top of the turret, saw the water close over the boat, completely submerging it.

Down it went!

What was to be seen? How did the water look? How far did the boat travel? Such are the natural questions, but it is to be regretted that the only answer to them is that nothing was to be seen but water—and muddy water at that—and further, that it was impossible to estimate the distance covered under water, owing to the fact that the boat was submerged in the middle of the river and in a swift current. The boat was down completly out of sight a number of times, and was maneuvered enough and in a manner to convince even the skeptical that the stay was only a question of an expenditure of power and a careful reduction of buoyancy, which latter desideratum was, of course, to be gauged in the present case only by the risk Mr. Baker was willing to take in admitting water.

The depth reached could only be gauged by the gradual diminution of the light coming through the glass sealed portholes; nothing could be seen a few feet away.

Goddard established a reputation as an estimator of depth on the first trip when, as Mr. Baker for the first time drove the vessel down quite a distance under water, he complacently remarked as the water darkened, "Now we are under, boss—sure!"

Mr. Goddard's belief was that in the trip herein described, the maximum depth attained was about ten feet.

During the time the boat was sealed there was absolutely no discomfort for want of air; it was very warm, though, on the inside, although the external air was quite chilly. All hands made the trip with coats off, and the pilot, it may be stated, owing to his hard work at the two wheels, was literally dripping with perspiration. The two wheels, one for the rudder and the other for changing the angle of operation of the two screws, having been newly fitted up, were quite hard to move.

At 5:27 P. M., just 35 minutes after Mr. Baker pronounced the boat "all tight," a white handkerchief was displayed from within against one of the glass windows in the turret, and the launch *Thos. McGraw*, with Mr. Humphrey on board, was seen making for the boat. After a futile warning to that gentleman not to step on the nicely balanced craft, but unfortunately only heard by those within the plate glass windows, the pilot lifted the turret lid and with a "swish" the heated air rushed out. The pumping in of the water ballast, it should be noted, compresses the air in the boat. At one time during the trip when the buoyancy was being reduced, it was found advisable to raise the lid of the turret slightly for a instant to relieve the air pressure and thus facilitate the pumping; of course, though, it should be remembered, no fresh air was admitted, so the 35-minute enclosure may be relied upon as a good test for that length of time. But even had the boat been opened once during the 35 minutes above referred to, the previous experience and a more recent one by Messrs. Baker and Goddard, both eclipsed the time the writer was enclosed. On Tuesday, May 24, these gentlemen were sealed in the boat, running part of the time on the surface and part under the water, for two hours and forty-four minutes.

When opened on Friday's trip the vessel was weighted down to a fine point. The pumps, which could be thrown into gear with the motor, were now set to work and as the boat was towed up the River Rouge, the water ballast was gradually reduced to its normal quantity.

At 6:07 P. M. the novel little craft was once more at its moorings at Boston's boat-house, and thus ended an experience, the remembrance of which will have a long life with one passenger at least.

One of the illustrations on the first page represents Mr. Baker steering the boat. The other shows the craft on the stocks, before launching, while the one on this page is a view taken by the reporter for the *Western Electrician*, from which journal these three were procured. They are all from photographs.

One of the most notable achievements in the rapidly multiplying applications of steel to structural purposes is the new chimney of that material in Chicago, the dimensions as given being a height of 250 feet, with an outside diameter of 9 feet 5", while the steel varies in thickness from $\frac{5}{32}$" at the top to ⅜" at the bottom. The lower 75 feet of the chimney is lined with firebrick 8" deep, formed to fit the shell compactly all around, and above this is lined with hollow tile. This lining is supported at intervals of 25 feet by an angle iron riveted to the steel shell; that is, the chimney is lined in a manner similar to blast furnaces and foundry cupolas, no expansion by heat being able to lessen its strength, and the joints are all hot riveted. The steel shell is carefully protected from corrosion and from any attacks by the weather, by painting inside and out. The weight of the chimney is spread to the foundations in the same manner or general way as that of the columns of the building, the base or foundation on which it rests being constructed similarly; the ground first, is covered with a layer of cement, then two layers of steel rails in cement and one layer of I beams, on which the cast-iron shoe which takes the shell of the stack rests. The capacity of the chimney is twelve 60" boilers, 20 feet in length. The outside diameter of this chimney is 9 feet 5", while were it constructed of brick it would be 16 feet 6".

Niagara Falls and Buffalo.

Elks Excursion via the Nickel Plate on Saturday, June 11; train leaves 10 P. M.; $3 round trip. Call on Committee of Elks, 172 Superior street, for tickets and other information.

Nickel Plate to Niagara Falls and Toronto.

Special Excursion Thursday, June 23. Niagara Falls $3, Toronto $4. Train leaves 10 P. M. Tickets good until June 30.

HOW TO USE A STEEL SQUARE.

BY JAMES F. HOBART.

There are a good many marks upon an ordinary carpenter's steel square that are not understood by all mechanics. To begin with, there are four kinds of steel squares constructed. First, the bridge-builder's square has a blade 24" long, 2½" wide, with a half-inch slot 21" long in the center of the square. This tool is fitted with an 18" tongue 1½" wide. Next comes the machinist's square, which has a 6" blade and a 4" tongue. The carpenter's square has a 24" blade and a 16" tongue, the two parts of the tool being two and 1½" wide, respectively. Next comes the millwright's square, with a 24" blade 2" wide, and an 18" tongue 1½" wide. The only difference between the carpenter's and millwright's square is the extra length of tongue possessed by the latter.

Among the various marks upon the square may be found a scale of equal parts for reading from drawings. There is also a diagonal scale for measuring bases. A table or board measure and a diagonal scale for measuring small fractions of an inch are usually there. The sides and diagonals of octagons are usually given, and on some squares, scales of chords and tangents are added. The method of using such scales and tables will not be described here; it is the intention to tell of the every-day uses of the steel square which are oft-times much neglected by mechanics.

Every man does not know that he can draw a circle with a steel square, two nails and a pencil. If a 6" circle be desired, and no compasses are at hand, it becomes a question of monkeying with a piece of string and a nail, or of driving two nails three inches apart through a piece of thin wood so that the nail points may serve as improvised trammels for drawing the required circle. All this is avoided by the use of the square as a pair of dividers. To draw a 6" circle, drive two nails exactly 6" apart into the board on which the circle is to be described. Let the nails above mentioned represent the diameter of the circle, and they must therefore, be exactly 6" apart from outside to outside. Lay a square outside the nails so that the blade will rest upon one, and the tongue of the square touch the other nail. Place a lead pencil in the corner where blade and tongue join. Revolve the square entirely around the nails, the corner holding the pencil approaching in turn first one and then the other nail. After the square has been passed entirely around the nails, a perfect circle will be found described upon the board into which the nails were driven.

The reason for a circle being described in this manner depends upon the old geometric proposition that an angle within a semi-circle is always a right angle. To put the proposition into plain English, it means that if a circle be described and a diameter drawn, then lines from any point in the circumference of the semi-circle touching the ends of the diameter, that the angle formed between said lines will be a right angle or "exactly square."

Putting the above into practice, if a carpenter desires to find the center of any circle, he need only to place the square thereon in such a manner that the corner of the square will just touch the circumference of the semi-circle. Draw lines along the edge of both blade and tongue, and at the point where these lines intersect the circumference of the circle a line may be drawn through the circle joining these points. The line thus drawn through will be the true diameter of the circle. This diameter may be measured and its center thus obtained, or the square may be revolved part way round the circle, the operation repeated and another diameter obtained, crossing the first one. The point where the two diameters intersect will be the center of the circle.

There are several mechanical problems that may be solved by the aid of a square, and about as good an illustration as can be shown, is as follows:

If a mechanic wishes to take two branch pipes from a main pipe of unknown diameter, and the main pipe is to be exactly the same capacity of both the smaller pipes, he can solve the problem very easily with a steel square. If one pipe is 3" in diameter and the other pipe 5", the main pipe to have the same capacity equaling the sum of the other two will probably be somewhere between 5" and 6" in diameter. To solve this problem with a square, take the diameter of one pipe on the blade and the diameter of the other pipe on the tongue, the distances are 3" and 5", respectively. With a rule or another square, measure across from one mark to the other. The distance thus found will be the diameter of the large pipe. By arithmetic the diameter will be found by adding the squares of 5 and of 3 and then extracting the square root of the sum.

If there be three pipes to branch from one, the size of two may be found as above, then the distance taken on one side of the square, the diameter of the third pipe taken on the other side a new diagonal measured which will be the sum of the three diameters. This matter applies equally well to squares as to circles; it also applies to right angles and other shapes having like angles, or sides in proportion to each other.

Not every mechanic has caught the idea of laying off angles with a steel square. If an angle of 45° or the "true miter" is required, it is pretty easy to find it by laying a square upon a straight line with equal figures on both blade and tongue just touching the line. For instance, place the square upon the edge of a straight board so that the 12" marks are just even with the edge of the board. A line drawn along either blade or tongue of the square will be at an angle of 45° with the edge of the board. To draw an angle of 60°, use the whole length of the blade, 24", and 13" on the tongue. When in this position a line drawn along the blade of the square will form an angle of 30° with the edge of the board, and a line drawn beside the tongue of the square will show an angle of 60°. Other angles may be studied out, provided the mechanic knows a little of the rudiments of geometry.

Building stair stringers and rafters is where the steel square is seen at its best. Probably the first time a mechanic had occasion to lay out a stair stringer or rafter for a building, he employed all the ingenuity mathematics and cuss words he knew of. The latter do not add to the accuracy of a man's work, but they do seem, in some instances, to prevent a severe attack of brain fever, to say the least.

After a mechanic has learned all about the steel square, he will be able to lay out stair stringers, rafters and hip roofs without trouble or profanity. If a stair stringer has 10 feet run and 8 feet rise, it is comparatively easy to lay a square upon a piece of board so that the figures 8 and 10 touch the edge of the board. Draw a line on the side of the square upon and through the 8" mark; then draw the square back, keeping it exactly upon this line until the figure 6 comes even with the edge of the board. The other side of the square will now mark a little less than 8", and a line can be drawn upon this side also; then a piece of board, being a litte less than 8"x6", may be carefully cut out and used as a pattern for laying out the stair stringers.

A strip of board nailed upon the diagonal edge of this pattern will enable it to be placed upon the edge of the stair stringer, and marks may be made on each side of the pattern for the purpose of sawing out for riser and tread respectively. As each step is to be 6" high, and the elevation is 8 feet, there must be twice as many steps as the elevation is feet high; therefore, the flight of stairs will have 16 steps. Mark off 16 lengths on the pattern on the edge of the stringer; then saw off from the bottom of the lower step an amount equal to the thickness of the tread to be placed upon the stringer. From the back side of the top step cut off a piece equal to the thickness of the riser, and the stringer will be finished.

The same method can be employed when laying out the rafters for a house. If a house 40 feet wide is to have a roof with a rise of 13½ feet, one of the rafters will represent the hypothenuse of a right angle triangle having 20 feet base and 13½ perpendicular. The cuts from the foot and top of the rafter may be obtained by taking 20" on the blade and 13½" on the tongue of the square, and applying these points to the edge of the rafter, marking along the blade of the square for the foot, and along the tongue of the square for the top. Next draw the blade of the square along upon the mark made beside it in precisely the same manner described for cutting stair stringers, until the 12" mark comes even with the edge of the rafter. Mark at this point where the tongue comes even with the edge. Then move the square along so that 12 on the blade comes to the mark thus made beside the tongue. Repeat this movement twenty times, which is one-half of the number of feet in the width of the building. The twentieth mark made by the tongue of the square will represent the length of the rafter and the cut by which the top is to be sawn.

For quick and easy work it pays to prepare two thin strips of wood so that they may be screwed together and adjusted to the square to represent the diagonal of any measurement which may be used on the blade and tongue. When strips of this kind are used it is much easier to adjust the square in making the 20 measurements above mentioned. There is not so much chance for error in figuring the size of pulleys. It is sometimes necessary to increase or decrease the speed of a shaft a few revolutions. To get just the size of pulley necessary for this increase or reduction of speed requires close calculation when figures are used, but a square will do it off-hand and correctly every time. For instance, it has been ascertained that a pulley 20" in diameter on a certain shaft will give a speed of 13 revolutions per second. If it be desired to reduce the speed to 11½ revolutions per second, the 20" pulley must be removed and one of different size substituted.

To solve this problem with a steel square, take 20" on the tongue and 13" on the blade. Place both of the marks on the edge of a straight board and draw a line parallel with the blade. Move the square parallel with this line until the tongue shows 11½" instead of 13. Notice the reading on the blade and edge of the board. This reading will be size of pulley required in place of the 20" concern to give the desired speed of 11½ revolutions per second. The principles involved in the calculations here made have been amplified and put into a more convenient shape for every day use.

In this perfected form some mechanics are familiar with the tool, but all do not recognize it in the slide rule. The principle upon which all slide rules work is that of the square and the piece of board above mentioned. There are several more problems that might be described with interest to the reader, but the editor says this article is too long; the writer has an impression that it is square. Reader, how is it?—[Industrial American.

THE Hine Eliminator Co., of New York, whose device defeated all competitors in the celebrated competition test of steam separators made at Cornell University, last year, report shipment of their eliminator to all parts of the country, among which they mention State University of Michigan, Ann Arbor; Purdue University, Lafayette, Ind.; State Agricultural College, Ames, Ia.; Polytechnic Institute, Worcester, Mass.; F. W. Montgomery, Milwaukee, Wis.; Central Electric Light Co., Chicago, Ill.; Washington Carbon Co., Washington, Pa.; Iowa Hospital for Insane, Independence; Crook, Horner & Co., Baltimore, Md.; Fordyce (Ark.) Lumber Co.; Stilwell Meat Co., Hannibal, Mo.; Savannah (Ga.) Crystal Iron Co.; Kearney (Ark.) Lumber Co.; Rix & Bonill, San Francisco, Cal. Merit will certainly find its due reward.

Grover Cleveland Club.

Excursion to Chicago via the Nickel Plate on June 18 and 20. Trains leave Cleveland 6:30 A. M. and 9 P. M. the 18th, and 6:30 A M and 7:10 P. M. the 20th. Tickets good seven days. $6 round trip. Special train returning after close of convention. For tickets, sleeping car berths, and other information call on Phil Voelkle, 1228 Pearl street; N. Scheid, Buhrer avenue; J Renck, Buhrer avenue; Rice & Schindler, Cor. Lorain and Penn streets; Fred Schweitzer, 500 Pearl street; Joe Bender, 19 Market street; Leonard Myer, 112 Merchants avenue, or Nickel Plate agents.

Elks.

Do not miss the Elks Excursion to Buffalo and to Niagara Falls on Saturday, June 11; train leaves 10 P. M.; $3 round trip.

NOTES ON LUBRICANTS—BURNING BITUMINOUS COAL.

The laws regulating lubrication, the action which the various articles used as lubricants have upon metals, and the chemical changes that are brought about by differences of temperature, have never received the consideration due them. Of late years, however, they have been treated more seriously by owners of machinery, and a writer in the Boston *Journal of Commerce* has compiled from various sources facts which users of machinery and engineers will find useful.

Competition among manufacturers to-day demands that the utmost caution be taken to reduce the wear and tear on the machinery, to avoid loss of time, and above all, to save fuel. In almost every case the correct use of proper oil will be found the precaution necessary.

A lubricant may apparently do good work and keep the part cool, but in reality the acid formed by the friction and heat of the journals is daily damaging the surface of the metal and will ultimately do great damage.

Consumers have for years been accustomed to rely upon the salesman, whose knowlegde of the goods he sells is usually found to be very deficient. Nor can every engineer's report on an oil be relied upon; many are really ignorant, while others are personally interested.

"Some months ago I engaged a salesman," says a writer in the *American Engineer*, "an active and intelligent engineer who professed to know something about oils, and whose general ideas about lubrication seemed sensible. Upon canvassing a part of the district allotted to him, with good success, so far as he went, the firm received a letter from him, saying: 'I used to think I knew something about oil, but have come to the conclusion that my knowlege will not extend beyond the outside of the barrel.' This is what nine-tenths of the engineers would come to if their knowledge were put to a practical test.

"A good oil should be used as sparingly as the nature of the bearings will permit. The amount of resistance (friction) generated by the bearings depends upon the number of revolutions a minute a machine is capable of making, and the amount of power necessary to run it. In the use of oil, uniformity of distribution is as important as the regularity of supply. A dry spot on a bearing will at once cause heating, and if allowed to continue, cutting will be the result.

"There is no department in a factory more important than the engine room. As the diminishing of friction will naturally result in gain of power, it is to the consumer's interest to learn by careful experiment the oils that are best adapted to run his plant, and to make the necessary tests of density, fire test and viscosity. By so doing he can be certain to receive exactly what his machine requires, and run it at the lowest possible cost.

"'Poor oils,' says an eminent engine builder, 'are a prolific source of injury, and often defeat the purpose for which a machine was intended.'

"If a machine is not properly lubricated it will bind, heat, and then cut, and the percentage of work added to the already overtaxed Corliss is sure to injure the engine, and certainly needs an extra dip now and then into the coal pile.

"No oil has been made that can economically lubricate all the journals of a mill. An oil running a heavy engine would not do to run a spindle or a fast-revolving dynamo. The former runs slowly and has great pressure and strains on its journals, and consequently requires an oil that will not spread too quickly, but with low gravity and high viscosity. The latter needs a pure mineral oil, viscous and quick-spreading, to enable it to enter into the closest parts of the bearing as rapidly as the speed at which it revolves necessitates.

"In making an oil for a specific purpose, the speed, power, pressure upon the journals, mode of application, and temperature at which it has to run should be known. This information in hand, an oil can be made to suit.

"The numerous tests that have been made by learned men at various times within the last 25 years tend to show that mineral lubricants, or compounds of mineral and animal, are the safest, and produce the best results.

"Professor Thurston remarks: 'Vegetable and animal oils are compounds of glycerine with fatty acids. When they become old, decomposition takes place, acid is set free, and the oils become rancid. Rancid oil will attack and injure machinery. Mineral oil does not absorb oxygen, whether alone or in contact with cotton waste, and cannot, therefore, take fire spontaneously; animal and vegetable oils do. Mineral lubricating oils are used on all kinds of machinery; they are the safest and cheapest lubricants, and are generally superior to animal and vegetable oils and greases.'

"According to experiments by Galletry and Coleman, it was found that 'mineral lubricating oils diffused through textile cotton do not take fire even at a temperature at which colza oil ignites, and that fatty lubricants to which 20 to 50 per cent. of mineral oil was added were thereby prevented from igniting.'

"Spon says: 'A mineral oil flashing below 300° is unsafe. The best oil is that which has the greatest adhesion to metallic surfaces, and the least cohesion in its own particles. In this respect fine mineral oils stand first. No oil is admissible which has been purified by means of mineral acids. Mixed oil, if properly compounded, possesses the special advantages of both classes.'

"The blending of mineral and animal oils does not merely consist in shaking them together, as is supposed by many, but as they are of different gravity, the globules of each must be broken and run into each other by agitation and heat, so that the oil will become one body. If this is not done, the animal oil will become separated, and standing in a heated room, the bad qualities will become manifest, and later, when used, the oil cannot do its work, and at once the quality is condemned.

"I had a case where a large mill owner was using oil said to be one part sperm and three parts paraffine, of heavy gravity. The price was lower than I knew it could be made for. Upon analyzing a sample drawn from the barrel I found it contained 60 per cent of sperm and 40 per cent. of paraffine, showing that the oil was separating. The sperm oil being lighter was coming to the top. Such oils cannot give satisfactory results.

"If you have any stipulated formula, have it made up for you by people who understand the business, and who have the facilities and appliances for doing it properly.

"Mr. Allen's experiments have shown that gumming is due to the action of free acid upon the metal bearings of machinery.

"The corrosion of bearings by oils has not received the attention it deserves, as the wear and tear of the metals and thickening of the oils has been attributed to other causes. Liquid oils corrode metals very evenly, so that the effect is not readily observed. Mineral oils contain no acid, nnless they have been carelessly refined.

"I. J. Redwood says: 'Mineral lubricating oil has the least action on metals; none on iron or brass. Tallow oil has most action on iron; castor, olive and lard oils have most action on brass. Rapeseed has most action on copper.'"

The same journal has the following on the proper conditions for burning bituminous coal:

The conditions necessary for burning bituminous coal properly are that the gas should be heated, and the air used to burn it should also be heated, and that the combustion should be carried on in intensely hot chambers, and that time enough must be given for the gases and air to thoroughly mix together before they are allowed to escape. These conditions can be provided in a properly built oven with air-heating flues in it, but they cannot be provided in the ordinary boiler setting, because the latter does not give sufficient room. The next direction in which waste may be found in steam boilers is in the boiler itself. If it has an insufficient extent of heating surface, the gases, although properly burned in the furnace, may be allowed to pass into the chimney too hot. Another cause of waste is that with sufficient extent of heating surface this surface may be so placed as not to be efficient; that is, the gases may be allowed to be short-circuited, or take short passages from the furnace to the chimney, without passing uniformly over the whole extent of the heating surface. I have found this trouble in ordinary tubular boilers, in which the hot gasses, after passing under the boiler, had a tendency to return through the upper rows of tubes and neglect the lower rows. The latter were, in consequence, rendered ineffective, and the gases passed into the chimney at a higher temperature than if they had been compelled to sweep uniformly over the whole extent of heating surface. Another cause of waste is the unclean condition of the boiler inside or outside or both. Scale on the water side of the heating surface of a boiler and soot on the opposite side are both non-conductors of heat, and their presence leads to waste.

The indications of waste in steam boilers are very plain. First, if the conditions of firing, draft, thickness of bed, etc., are right, there will be a very high temperature in the furnace. If there is a low temperature, either from imperfect combustion or from too great amount of air, there will be a waste, so that high temperature in the furnace is the first condition of economy in a steam boiler. The second prime condition is low temperature in the chimney. The heat produced in the furnace must be absorbed as completely as possible by plenty of heating surface, and by clean heating surface, and by surface properly disposed so as to intercept the currents of gas, and the result will be a low temperature in the chimney. Smoke is also an indication of waste, and wherever smoke is seen there also will be unburned combustible gases, which, as before stated, may be prevented. Other wastes in steam boilers may, however, exist, although there is a low temperature in the chimney, such as passage of cold air through the rear portion of the furnace, which the fireman is very apt to leave uncovered. Second, leaks of air through the setting of the boiler. Third, leaks of water into the flue passages. Still another cause of waste quite frequently is leaky blow-offs where a valve discharges into a sewer and its leaky condition is unobserved. Another cause of waste in a steam boiler, which is found in some establisments, is the waste of steam through a safety valve. In some places where the demand for steam is irregular, but when needed it must be at a certain pressure, and as the boilers are not safe to carry at much higher pressure, the safety valves must be set at a very little above the working pressure. When the work ceases for a short time, steam accumulates in the boiler and is blown off through the safety valve. The remedy for this kind of loss is to have stronger boilers in which the pressure can be allowed to accumulate above the working pressure. In all places where the demand for steam is irregular, there should be great attention paid to the regulation of the damper so as to prevent fuel from being wasted when the demand for steam is small. Another cause of waste is a grate surface too small, causing the grates to be easily choked with clinker, and requiring more work of the fireman to keep them clean. Every time the fire is cleaned there is a waste caused by the cold air rushing in the doors and by unburned fuel being withdrawn with the clinker.

Then there is waste heat in the chimney. With a boiler properly set, running to its normal capacity, it is not usually practicable to reduce the temperature of the flue to less than 100° in excess of the temperature of the steam in the boiler, or say to 400°. In actual practice 500° is more common than 400°, and, in bad practice, I have seen it over 1,000°. But if 400° is the lowest we can get, and the temperature of the air entering the boiler room is 80°, the hot gases leave the boiler 320° higher than the temperature of the air entering. As the temperature of the fire is not usually much above 2,000°, say 2,400° as a maximum, the heat thus lost in the chimney is from 13 to 16 per cent. of the total heat generated by the coal. This loss is unavoidable with an ordinary boiler and chimney; first: because a moderately high temperature is necessary to make a good draft; and, second, as already stated, we cannot reduce the temperature of the gases down to the temperature of the steam. But much of it may be saved by the use of an economizer or set of tubes in the chimney, through which the feed water is passed, and heated from entering temperature to, or nearly quite that of the boiler. In large plants considerable economy of heat may be had by the use of these economizers, using either a very high chimney, or better, a forced draft, either blowing air in under the grates or exhausting it out after it passes the economizer.

AN ELECTRIC BELLE.

Miss Gretchen Van Tassel belonged to one of the oldest Knickerbocker families in Harlem.

Mr. Edouard Constant belonged to one of the most ancient Huguenot families in New Rochelle.

Miss Van Tassel traced her ancestry back to the Van Tassels, burgomasters of Medemblik in the days of Van Dyck. On her mother's side she was distantly of kin with the Schimmelpennincks.

Mr. Constant, in retrospective moments, followed his ancestry back to Richelieu; not the Cardinal, but the Cardinal's uncle. The Constants came from Vichy, Department of Allier, and were older than the springs.

Albeit these young people were ancient in their origin, they were modern in their tastes. For both were enthusiasts in science. Each had a brilliant fad—Electricity!

Miss Van Tassel contributed bright articles to the *Electrical Review*. She took her work very seriously, for she thought that electricity was not a subject to be made light of.

Mr. Constant was an amateur whose opinion was highly valued by the Board of Electrical Control. It often invited him to throw some light on the subject of street illumination. He was a very magnetic man, and would have been highly successful in politics had he, like Mr. Bagehot, joined politics to physics. His speeches on Electricity were luminous in argument and corruscated with wit.

One sunny afternoon Mr. Constant heard the telephone bell jingle in his office.

"I suppose they want to consult me at the Board of Electrical Control," said he.

"Hello," came a sweet voice.

"Hello," said Mr. Constant, with great uncertainty.

"Are you the Board of Electrical Control?" said the sweet voice, confidently.

"I am the technical knowledge, the precise data, and the opinions of the Board of Electric Control," said Mr. Constant, modestly. "Pray, who are you?"

"I am Miss Van Tassel—"

"Not Miss Van Tassel the author of "The Sun as a Solar Battery?"

"Yes."

"Oh!"

"And you?"

"Mr. Constant—"

"Not Mr. Constant the writer of the profound essay on "The Electrical Energy of Ether on Space?"

"Yes."

"Oh!"

Just at this moment the central office severed the wires.

"That 'oh!' was delicious," said Mr. Constant.

"What awe and admiration in his 'oh!'" thought Miss Van Tassel.

The two electricians were soon carrying on a charming courtship by telephone. Cupid, like a rope dancer, traveled by wire. He wore the wings of lightning and carried a quiver full of electric arrows.

One day Miss Van Tassel telephoned to Mr. Constant that she had encountered a problem in electricity that was "too awfully deep for anything."

Mr. Constant chivalrously offered to assist her to solve the problem, and received an invitation to call at her house.

The following evening Mr. Constant polished his shoes by electricity, parted his hair with an electric comb, smoothed it with an electric brush, and then started up town to call on the fair electrician, with whom he already had a slight acquaintance by telephone, by telegraph, and by "lightning district messenger."

He stepped aboard an electric street car of the Madison avenue line and rode through avenues illuminated by electric lights. So brilliant were the Brush lamps that he was able to read the *Electrical Engineer* as he stood on the front platform of the car, which the storage batteries were driving merrily along.

As he tripped up the steps of Miss Van Tassel's home he observed an electrical storm in the sky. He brushed his feet on the electric door-mat, and then rang the electric bell. A wide-awake maid servant pressed an electric button and the door opened. Mr. Constant was ushered into the drawing room, which was kept agreeably warm by an electric stove, and was softly illuminated by mellow electric lights.

Miss Gretchen Van Tassel fluttered into the drawing room. Her golden hair was like the pale golden light of an Edison lamp. Her eyes sparkled like a Leyden jar. She extended her tiny hand. Mr. Constant felt the electric touch of her finger tips. On her hand a pure white diamond shone with electric fires.

They talked pleasantly about electro-magnetism, alternating currents, positive poles, magnetism in politics, "the Georgia Electrical Girl," incandescent lights, live wires and other living issues.

Miss Van Tassel's enthusiasm was electric. Suddenly she paused in her conversation, drew aside the window curtains and said: "See the electrical phenomena in the sky!"

Mr. Constant and Miss Van Tassel walked out on the veranda and enjoyed the play of colors of the aurora borealis. The northern sky had organized a *fete* in honor of their happy meeting.

Mr. Constant was a frequent visitor at the happy electric fireside of Miss Gretchen Van Tassel. Her home was a magnet which drew him irresistibly. Often the electric lamp in the drawing room was turned low, and the two talked in soft electric whispers.

Soon the happy Harlem sparrows held meetings on the telegraph wires and gossiped of the approaching nuptials of Edouard Constant and Gretchen Van Tassel.

The marriage was celebrated this week at the bride's home. All the society people who move in the best electrical circles were present. As the bride and the bridegroom entered the drawing room they were welcomed by a chime of electic bells. Then an automatic electric piano played the wedding march from "Lohengrin." In her golden hair the bride wore a comb arched with tiny electric lights that shone like diamonds.

All at once many beautiful bouquets in the room became luminous and shed a rare radiance. They had been suddenly illuminated by many little electric lights concealed among the roses.

The happy pair stood before the minister. The words were spoken, there was an electric kiss, and the continuous current of their happiness had begun.—[L. H. Tupper in "Truth."

ELECTRIC MOTORS IN MACHINE SHOPS.

It is commonly supposed that electric motors are chiefly suitable for transmission of power over long distances. This is not the case, however, and the time is now come when it will pay to use copper conductors instead of belting, even in small factories.

The first objection that will be raised is on the score of expense. But it must be remembered that a very much smaller steam plant is needed. In driving a large machine shop the waste of power in the shafting is really enormous. When all the machines are in use, the efficiency of transmission through many countershafts is very low, and in practice very few machines are doing heavy work simultaneously. At any one time a large proportion of the machine tools in a shop are either having work taken off or put on them, or are taking light finishing cuts. In an electrical system the dynamo has to supply only the power actually needed, so that quite a small engine and dynamo will drive a large shop. The small engine and dynamo will probably cost less than the large engine now necessary.

Coming now to the motors, they need not be large. It is surprising to many to find what a little power will drive a large tool. The motors will, no doubt, cost more than the usual speed pulleys and countershafts, but not much more. It is questionable whether the whole cost of the motors and conductors would be as great as that of the shafting and belting now used. Speed cones are unnecessary, as the motor can be mounted as part of the machine, and if direct currents are used it can be fed under different pressures, or, if alternating motors are employed, circuits of various frequencies can be employed. The advantages of such an electrical system are that the forest of belting, with its attendant turmoil, is done away with, and a clear space is allowed for overhead cranes. A great part of the shaking and jarring is due to belting, so with motors the machinery will run smoothly and noiselessly. The attention needed will be much smaller, as the whole of the overhead gear is done away with, and the motors are within reach of the machine attendant. If multiple-current motors are employed, no commutators are necessary, and the motors thus add no working surfaces to the machines.

The next advantage is a large saving in the coal bill. The whole of the works can be run from one engine and boiler-room of comparatively small size—placed conveniently as to coal, water and position. This in itself means a great saving in capital, coal, labor and space. In most engineering works there is an engine for each building, and various small engines running punching and shearing machines and hydraulic pumps. Sometimes special engines are used for traveling cranes or traversing platforms. An overhead crane driven by shafting or by ropes has often a very low efficiency, as measured from the weight raised. It is hardly necessary to add that the same plant, if made larger, would do for lighting the works at night. The electric light, on any moderate scale, is far cheaper than gas, and it is more convenient, as, by means of flexible conductors, it can be put in any position to suit the workman. The days of tallow "dips." stuck in $\frac{5}{8}''$ nuts, are numbered. If alternating currents are employed electrical welding is available wherever it is wanted, and the ordinary forges can gradually be replaced by electrical heating as workmen become better educated in these matters.

We must not overlook another advantage with direct currents, and that is constant speed. In many mills there is the greatest difficulty in keeping the speed constant enough for spinning. All sorts of governors have been devised. All this is avoided by the use of motors. A direct-current motor will run at constant speed, even if the main engine and dynamo vary. The speed of such a motor is also independent of its own load.

It is scarcely to be expected that works managers will remove their belts and countershafting to replace them by motors in existing shops; but, before making any further extensions, it would be wise to consider the motor and the lighting question carefully; and this, we feel sure, will result in adopting motors, and eventually, in the gradual replacing of belts throughout the works.—[Industries.

Low Temperature Obtained by Carbonic Acid.

It appears that very satisfactory results have been reached in experiments made with M. Caillette's apparatus for producing a temperature of from 90° to 110°, F. below zero, by the expansion of carbonic acid. The apparatus consists of two concentric vessels with a small annular space between them, a spiral coil being placed inside the inner vessel, and this is put in communication with a closed vessel containing liquified carbonic acid gas. At its lower end the coil is connected with the annular space, and at its upper a stop-cock is fitted. When used the inner vessel is filled with alcohol, the stop-cock on the carbonic acid vessel is fully opened, and the cock on the spiral partially opened, when the liquid passes slowly into the coil and takes the form of snow. From the coil it passes into the annular chamber in which are placed pieces of sponge soaked in alcohol, which arrest all the acid that has not become gaseous, while the gas itself passes out of the apparatus through a bent tube. With about $5\frac{1}{4}$ pints of alcohol in the inner vessel, and consuming $4\frac{1}{2}$ to $5\frac{1}{2}$ pounds of liquid carbonic acid, a temperature of 95°, F., can be obtained in a few minutes.

CONNECTION OF STEAM MAINS TO BOILERS.

We have discussed this subject on several occasions but our experience and observation indicate that it will do no harm to say a little more yet.

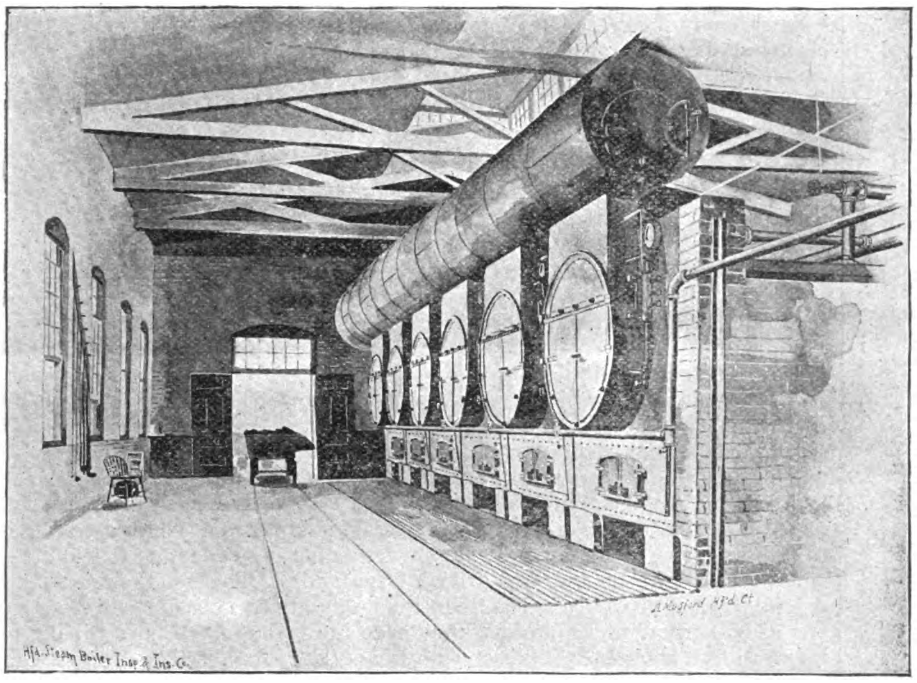

Hfd. Steam Boiler Insp. & Ins. Co.
A. Mulford Hfd. Ct.

FIG. 1.—A MODEL BOILER ROOM.

Where steam drums are used in connection with boilers set in battery, they are too often connected with the boilers by short cast iron or wrought iron necks, which make so rigid a connection that the least independent movement of one of the boilers is almost sure to start a leak, or break something. The force exerted by expanding iron is tremendous, and the piping and connections of boilers should always be arranged in such a manner that slight movements of the boilers, from expansion and contraction, cannot give rise to severe strains at any point. Numerous accidents have happened from the use of too rigid steam connections, and accidents will continue to happen so long as such connections are used.

The accompanying engravings are from photographs of the boiler-room of a manufacturing company in New England. The boilers, settings and piping were designed by the Hartford Steam Boiler Inspection & Insurance Co. The particular purpose that we have in mind in producing these engravings is to call attention to the manner in which the steam main is connected with the boilers. The steam main may be seen in the upper right hand corner of Fig. 1, back near the rear wall of the boiler-room; but it is more distinctly shown in Fig. 2. The center of the steam main is 4 feet 10 inches above the upper surface of the boilers, and connection is made with it by means of risers and horizontal pipes, arranged as shown in Fig. 2. The length of each riser, in the clear, is about 3 feet 6 inches, from the nozzle to which it is attached to the angle valve at its upper end: and the horizontal pipe that runs from each of these valves to the steam main is 7 feet long in the clear. There is no harm in making both the risers and the horizontal pipes longer than is here indicated, when there is sufficient room, but experience has shown in the boiler-room illustrated herewith, that the dimensions given are suffieient to provide for the slight movements that the boilers and piping have in the case under consideration. These boilers are 66 inches in diameter, and have 72 tubes each, 18 feet long and 3½ inches in diameter. There are six in number, and, as shown in Fig. 1, they are set in a single battery. They supply steam for two large engines, for a bleachery and for two dye houses, one of which is 400 feet from the boiler-house. The drying machines consume about 150 horse-power, also, and steam is used for heating, pumping and other purposes. The main steam pipe is 12′ in diameter.

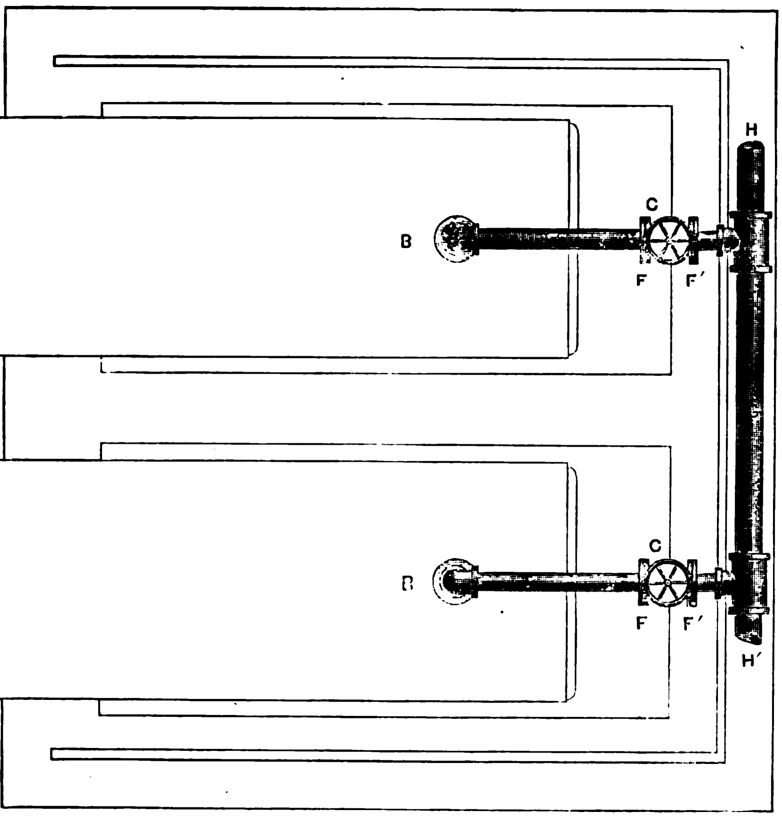


FIG. 3.—PLAN VIEW TWO BOILERS.

It will be noticed that these boilers have no steam drum. We believe steam drums to be unnecessary in most cases where they are used, but we are aware that many experienced engineers claim them to be indispensable. If such drums are used, they should be connected to the boilers in the way the steam main is shown in Fig. 2 is connected, with risers and horizontal pipes.

Fig. 3 gives a plan view of two boilers connected as explained above, except that in Fig. 3 the stop valves are placed in the horizontal pipe instead of at the top of the riser. We prefer the angle valves shown in Fig. 2, though the arrangement in Fig. 3 works satisfactorily. It will be noted that by a mistake of the engravers the valves C C, in Fig. 3, are shown with the stems *vertical* instead of *horizontal*. They should, of course, be horizontal, as otherwise the valves will trap water.—[The Locomotive.

Electric and Oil-Consuming Steam Vessels for the World's Fair.

Among nautical men, engineers and electricians at Jackson Park the absorbing topic of the day is the competitive trial of steam and electric launches. Newspaper men and technical experts made the trip around the little lakes on the new electric boat, the first on the waters of the great lakes. The launch was designed by Miles G. Nixon. The trial run was merely to test a new form of storage battery, said to be an improvement on the old Plante battery. No applied active material is used in their construction, the plates being pure strip lead, positive and negative plates being the same. In the process one-half of the lead is turned to an oxide, forming the active material; the other half acts as the conductor. This is a saving, and permits rapid charging and discharging. Each plate has a superficial area of four square feet. Electrolite is the fluid used, and for a capacity of 200 ampere-hours the weight is but 37 pounds. The boat has 104 storage battery cells, which operate a five horse-power motor. The cells are coupled in series of 52, 26 and 13, giving three speeds, at all of which the screw is reversible. These cells can be charged for a run of 140 miles.

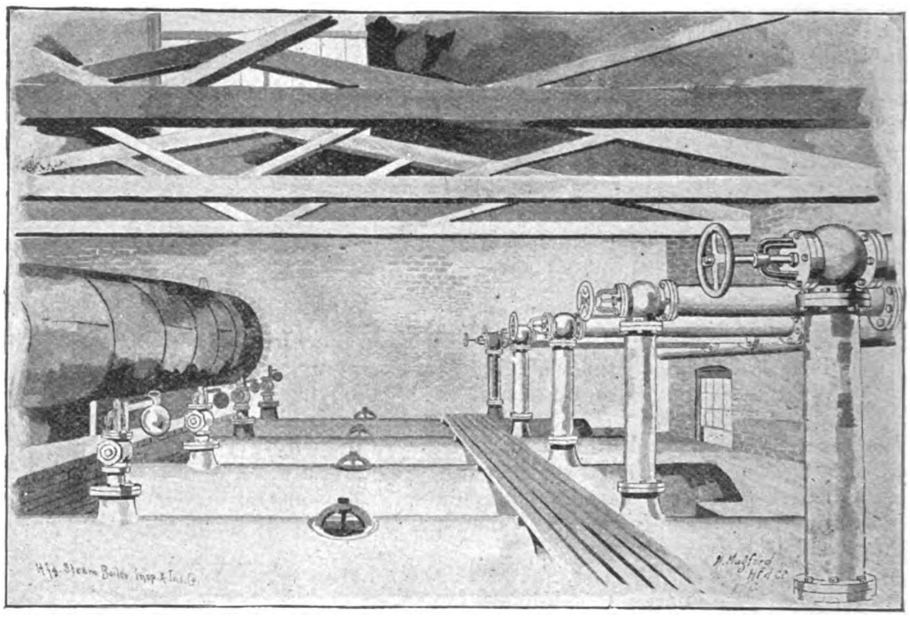

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FIG. 2.—SHOWING CONNECTIONS TO STEAM MAIN.

The same company has also a steam launch which will enter the competition, and to it the party was transferred for a cruise on the lagoons. This vessel uses headlight oil as fuel. Its tank can hold oil enough for a 250-mile run. The system is safe, as a match can be thrown into the 150-test oil used without danger of explosion. The motive power is a double-acting compound engine, designed on the most approved marine engine models. Besides the advantage of being light and of high speed, it is economical in the use of fuel. It has no dead center. The boiler is of copper, and on the improved water-tube order, and showed itself a rapid steam maker. A pleasant feature was the absence of all smoke, smell, noise and heat. If the company building these boats secures the franchise it will put on three kinds of craft—the omnibus, making 16 stops; the express boats making two stops, and the cab, to hold four persons and intended for hire by the hour.—[Chicago Herald.

The Wisconsin Monolith and the Big Stone.

It will be interesting to know just what machinery will be used for raising and handling the huge "Wisconsin Monolith" to be exhibited at the World's Fair. The contract for transportation has not yet been let, but it has been decided to take it by water to Chicago, and a big scow has been obtained to transport it. The scow is 138 feet long 28 feet wide, and draws about 6 feet of water when loaded. It can be moored close to the shore of the island, so that the stone will have to be moved only about 200 feet on the land. It will be moved on rollers; when it reaches Chicago it will be moved in the same manner. A special dock to unload it will have to be built as the water at Jackson Park is too shallow. Mr. Buetrin has not yet formulated his plans for raising the big stone, but he says he will get it up all right.

As this stone will be longer and thicker, and twice as heavy as the New York obelisk, and for that matter larger and heavier than any stone erected in modern times, he cannot adopt the methods of Lieut. Gorringe and the engineers who erected the obelisk, but must originate a plan of his own. With him the difficulty of the operation is increased by the softness of the stone to be handled. "The New York obelisk was hard," he said, "and like handling an iron column compared to this stone. We will have to put this in a strong casing and truss it securely. It is too heavy to swing on trunions, as the New York stone was swung, but we have screws and tackling enough, and if one will not swing it up the other will."

They Want it over There.

The Hon. Peter B. Burt, member of the Common Council, of Glasgow, is in America looking out for an electric motor system that can be easily adapted to the somewhat uneven streets of Glasgow.

"At present our tramway systems are controlled by a monopoly," he said, "but their lease expires early in 1894, and then the city of Glasgow will put in and operate its own street railways."

When questioned as whether any special benefit was to be derived by the municipal control of the street railway, he continued: "Yes, there is no doubt it will be a great benefit to the city. In the first place we will charge only 2 cents for the whole length of the city, whereas they now charge 2 cents a mile. There are several very good reasons why Glasgow should own its street railway, most prominent of which is the fact that our citizens are deeply opposed to monopolies and corporations of any sort and are loudly demanding that the city take control. The city of Glasgow controls and operates its gas and electric lightng plants, its hydraulic power, all public markets, stockyards and water works, and there can be no doubt that the municipal control of these is a great benefit to the people. It not only furnishes its goods at a much lower figure than a monopoly would, but it pays its labor a higher price and exhausts its profits to the benefit of the people."

Making Spiral Springs.

A writer in a mechanical journal sfates that, in the frequent dilemma of the spiral spring of an instrument getting broken, it is much more satisfactory to make one than to send the instrument away for attention. In making them, the best of spring steel wire is to be used, selecting a smooth iron rod the size of the spring to be made, carefully drawing the temper from the metal, and fastening the rod and one end of the wire in a bench vise; the wire is now to be wound evenly and closely around the rod until the length of wire required for the spring is obtained, when the rod is to be removed from the vise, and, fastening one end of the spring to the rod and taking hold of the other end, the spring is to be drawn along the rod until the spirals are the correct distances apart. To give the amount of spring wanted, it is to be fastened firmly to the rod. The spring and rod are made red hot, and both quickly plunged into cold water. After drying, rubbed all over carefully with oil, and moved about in the flame of a lamp until the oil takes fire, the spring is thus insured the proper temper. This process is said to be much preferable to the making of such springs direct from tempered wire.

Remarkable Specimens of Metallic Iron.

THE well-known French scientist, M. Daubree, received recently some remarkable specimens of metallic iron, found at a depth of several yards in the auriferous deposits at Priskanavnyi, near Berezowsk, in the Urals. Analysis points to the presence in the metal of a very slight quantity of platinum, with no trace of nickel, the iron being consequently of terrestrial origin. On the other hand, it shows an extremely leaved and figured structure, which can only be interpreted by supposing that, during its passage towards the earth's surface, it was subjected to mechanical actions like those which develop explosive gases generated by ignition of gun cotton.

Tilden Club.

Excursion to Chicago via the Nickel Plate on June 18 and 20. Trains leave Cleveland 6:30 A. M. and 9 P. M. the 18th, and 6:30 A. M. and 7:10 P. M. the 20th. Tickets good seven days. $6 round trip. Special train returning after close of convention. For tickets, sleeping car berths and other information call on A. Whitaker, President, Brooks Oil Co.; T. J. McManus, Secretary, room 27, 106 Euclid avenue; H. M. Brown Co., 138–140 Ontario street; T. O'Brien, 220–224½ Bank street; A. T. VanTassel, 250 Detroit street; W. S. Snider, Sheriff's office, or Nickel Plate agents.

Elks Excursion.

To Buffalo and Niagara Falls via the Nickel Plate on Saturday, June 11th. $3 round trip. Tickets good returning until June 16. Train leaves 10 P. M.

Notice: Extension of Limit.

All tickets sold over the Nickel Plate to Chicago and return, account Democratic Convention, June 18 and 20, will be good returning until July 8.

Chicago Excursion.

Nickel Plate tickets will be good returning until July 8.

Niagara Falls $3. Toronto $4.

The Nickel Plate will run one of their popular Niagara Falls excursions, leaving Cleveland at 10 P. M., Thursday, June 23. Tickets good returning on regular trains until June 30, also on special train leaving Buffalo at 9 P. M., Saturday, June 25. For tickets, sleeping car berths and other information call on L. Perczel, Agent, West Side, 538 Pearl street; Browne & Thompson, City Agents, 224 Bank street, and 156 Public Square; or Agents at Nickel Plate depots.

$6 to Chicago and Return.

Grover Cleveland Club Excursion to the Democratic Convention, June 18 and 20. Tickets good returning until June 27.

$6 to Chicago and Return.

Tilden Club Excursion to the Democratic Convention, June 18th and 20th. Tickets good returning until June 27.

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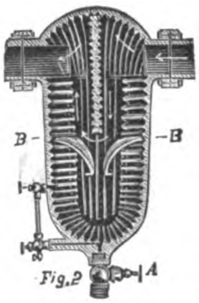

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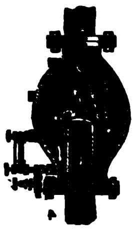
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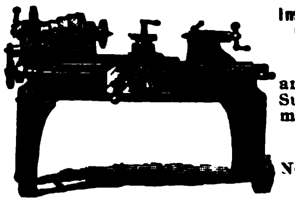

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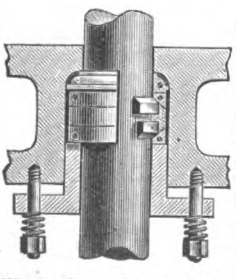

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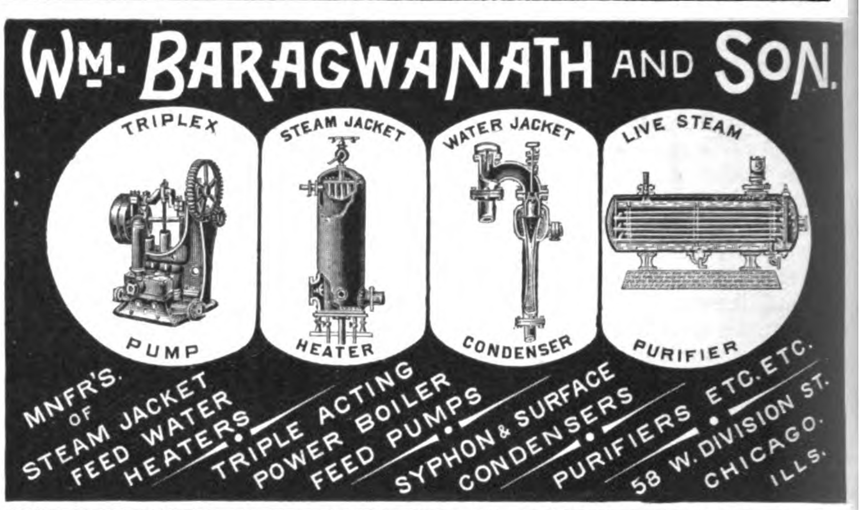
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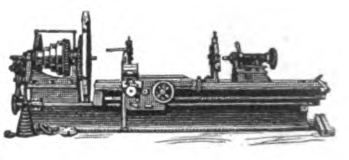

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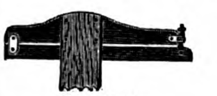

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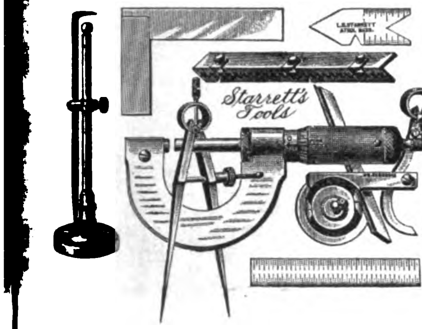

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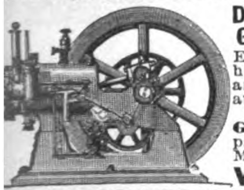

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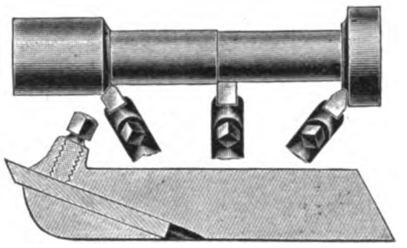

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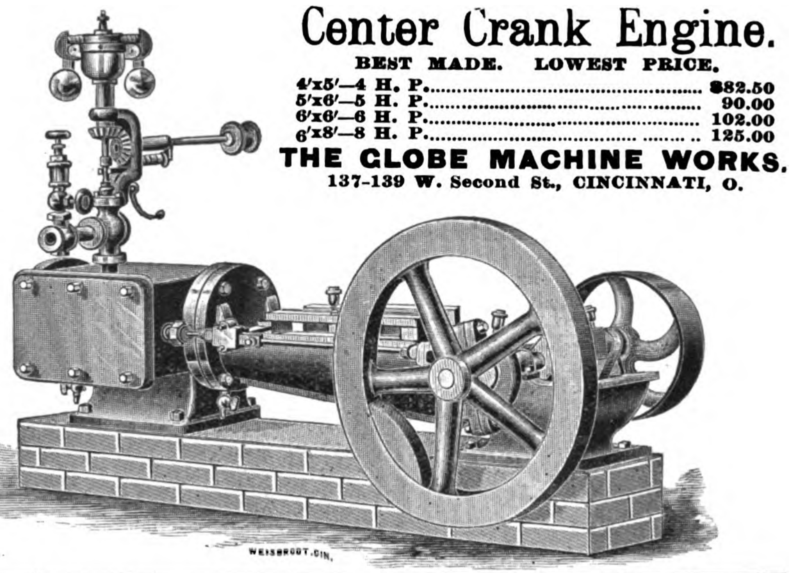
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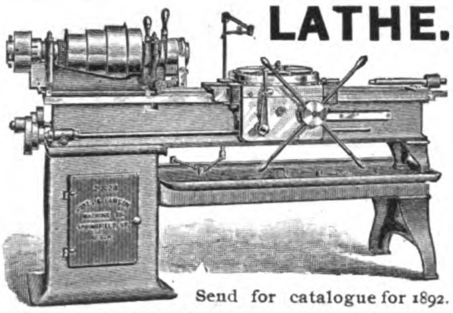

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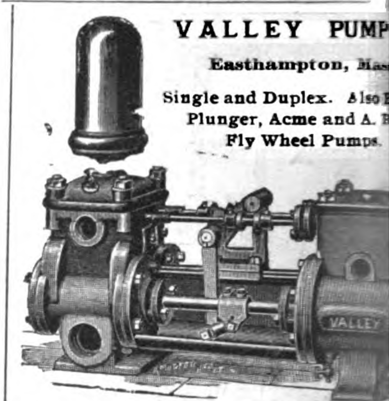

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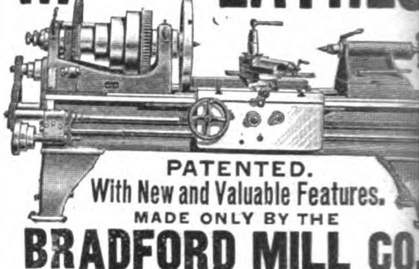

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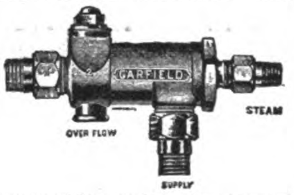

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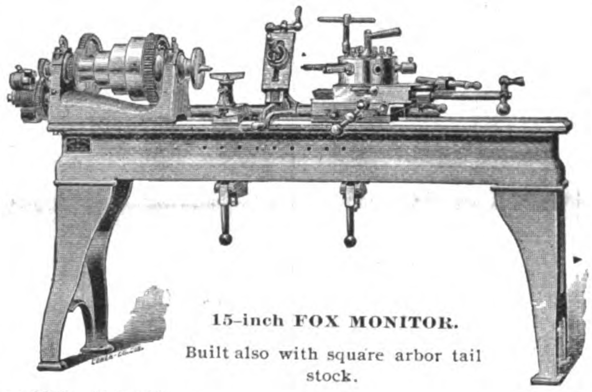

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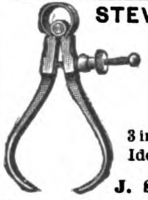

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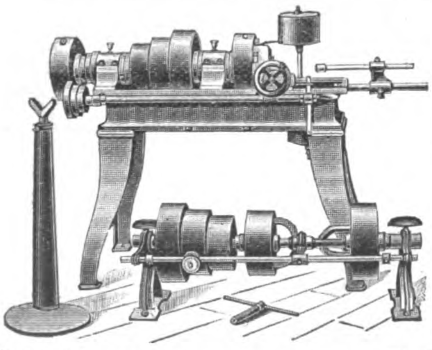

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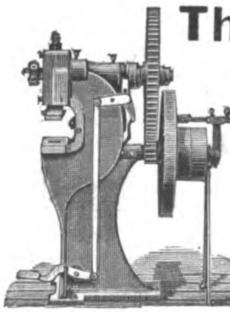

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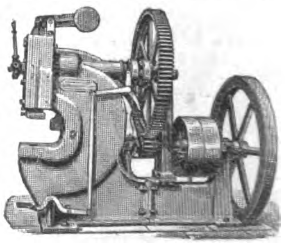

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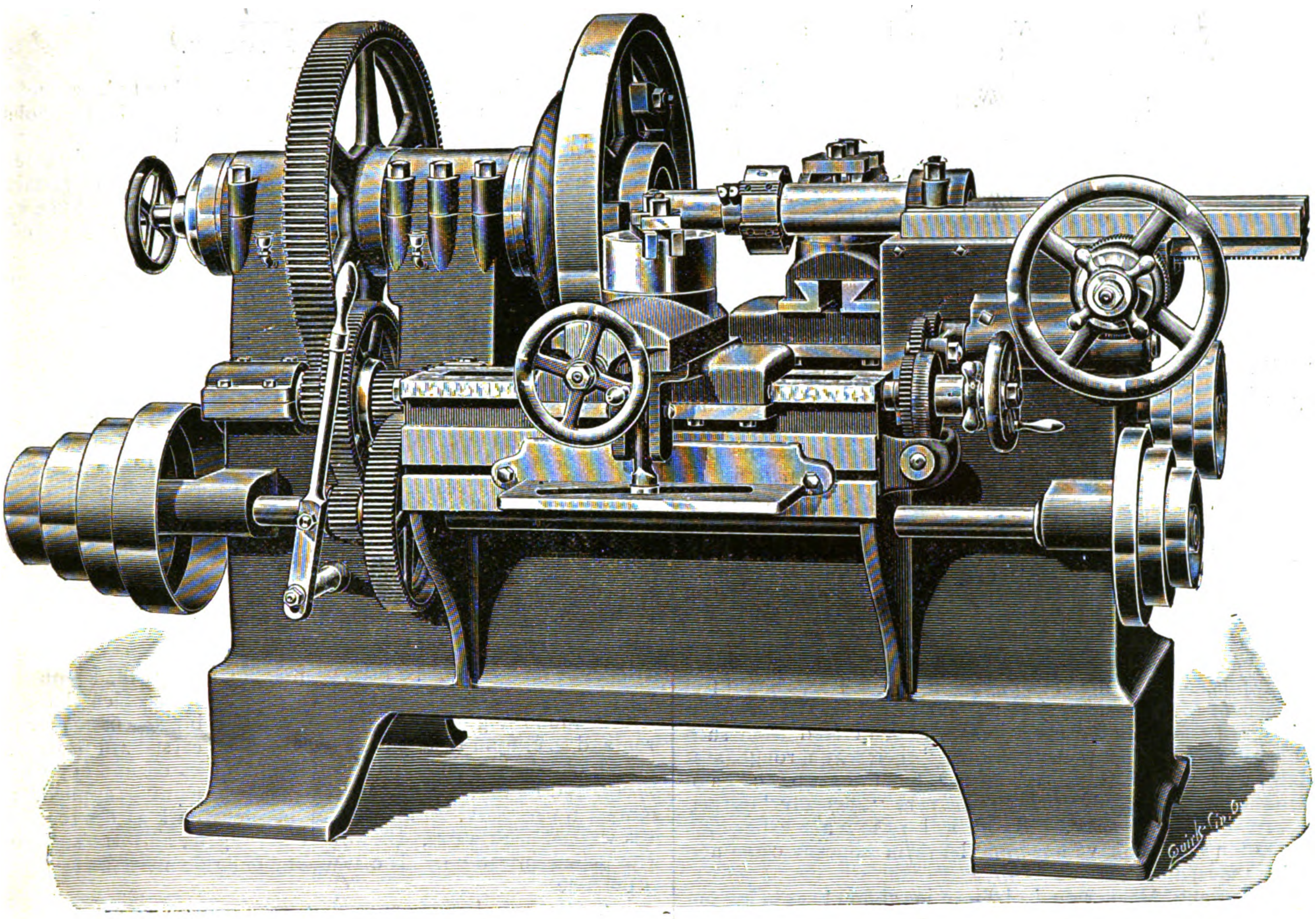
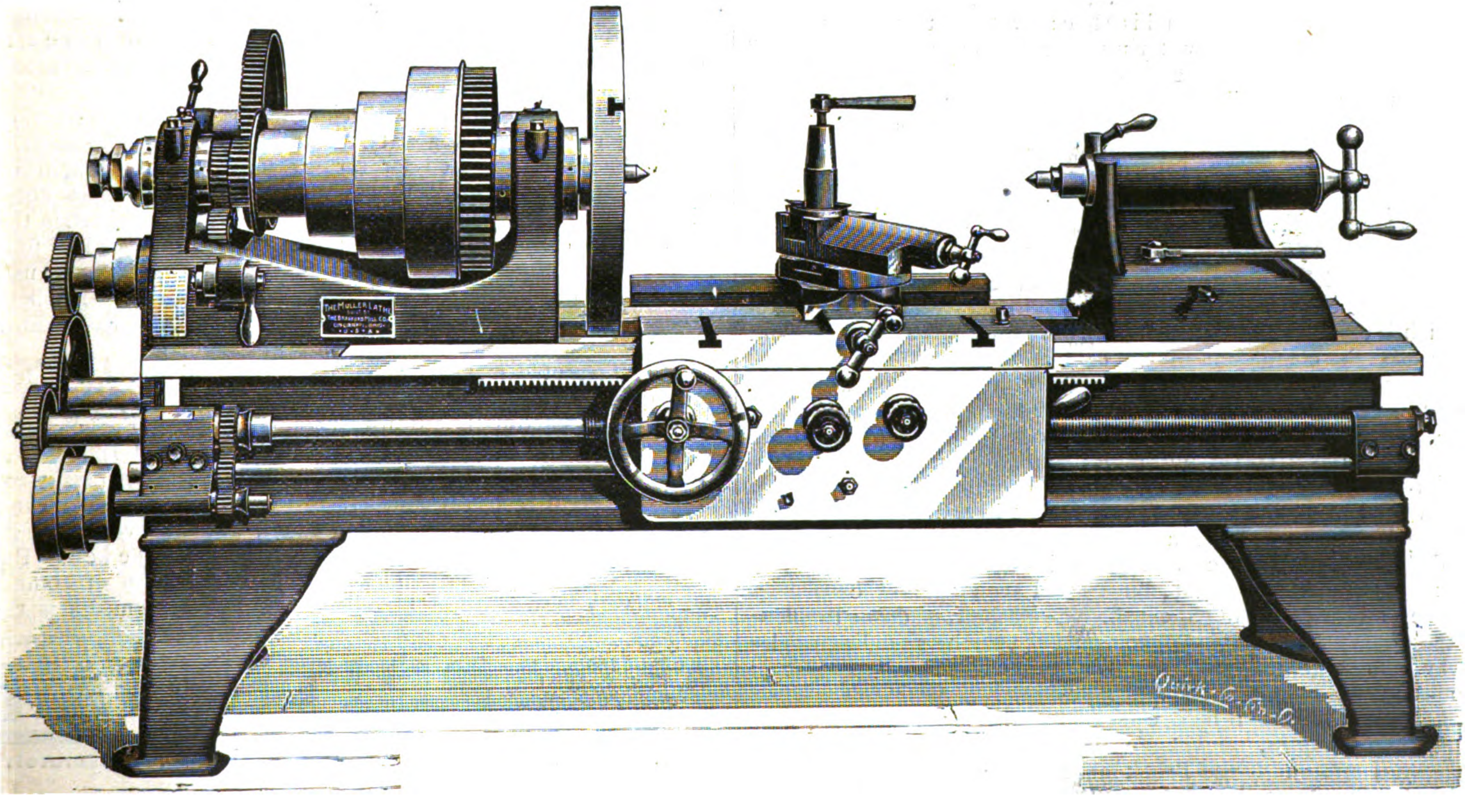


A MOTOR GEAR LATHE.—(See page 5.)



THE MUELLER LATHE.—(See page 5.)

LECTURES BY THE OLD MAN.

Good morning, John, you are looking fresh in every sense of the word this morning. What brings you to the office, and how is the new Brown engine doing? Have you got your fireman educated so he can scatter that anthracite waste over the furnace fire without knocking the fire doors off? Glad to hear that you have, and that you think he will prove a coal saver for you. Your statement made me regarding the money to be saved and the advantages to be had by getting a new engine in place of the old one was very well done, only your figures were too strong to submit to the firm, even admitting that they were about right. Those indicator cards were vile and were in strong contrast with the one you took yesterday from the new one, and while our acquaintance has showed me that you have spent considerable midnight oil in studying "Hemenway's" or some other way's, indicator practice, those cards have enabled me to put into practice another scheme of mine. It is this: In addition to your present duties in overseeing the engine and boiler-rooms, I will put all the shafting, hangers and belting under your control and charge, expecting you to see that it is kept in alignment, belts properly laced and always tight so that we will never be compelled to lose valuable time, as we have this week, sewing belts and shoring up hangers. Your responsibilities also include the countershafts and the belts right down to each machine throughout the whole plant, and you will have the night watchman to help you in addition to any one of the laborers you may choose, and your fireman. There must be no time lost hereafter on account of loose belts, hot bearings, cut shafts or stuck pulleys without some one being responsible for it. I now put that responsibility upon you, and your salary from this time on will be $24 a week. Do you think well of the prospects? All right, go about your new duties as "engineer of the plant," and always remember that every minute lost with me is money lost to the firm, and every moment of time you save is so much profit to the firm, and multiplies into hours and days at the end of the fiscal year. Any suggestions you may have to make, bring them to the office, and we will see if they are good.

Oh! you wanted to ask a favor of me? That was what brought you to the office. Well, let's have it and see what I can do for you.

You would like to get your sister's boy in here to learn his trade as a machinist. She is a widow and he is her only boy, and you would like him to be of some good to her. Say, John, just sit down and listen to me a little bit. I guess we can spare the time. I am willing to take this boy you speak of as an apprentice ON TRIAL. Not because he is *your* sister's boy, not because he is the son of a widow, but simply on account of his being a boy and desirous of learning something about a way in life that will make him of benefit to his country and the human race in general. If he fails to come up to our standard he cannot expect to stay. We want to instil into our apprentices' minds the all-important fact that at the end of their three years' service with us, their trade has not been learned but that we have done all we could to teach them the fundamental principles and lay the corner stones of eventual success, and that the "trade" will never be completed until the sands of life are all ebbed away. They should feel that this is a school of instruction, just the same as Sibley, Stevens or Purdue, only not possessing all the great benefit to be derived from such institutions of learning, we allow them to "work" their way through, as it were. We don't want any "specialists" either, for the shop records of our country are showing how easily grown up men are "specially" learned to do certain parts of machine work. So we will try to make better men of the next generation than we have now, and let them honestly claim and deserve the title of mechanics.

You know our friend Meeker don't believe in apprentices being put to various kinds of work in a shop, and doubtless you have read his arguments thereon. So, taking his theory and applying it to himself, we will suppose that when he started to school his teacher saw at the end of a few months that the Meeker boy was as dumb as an oyster in geography, bleated through the alphabet like a Rocky mountain goat, and was only at his best when making pictures of men and dogs on his slate: Should that teacher have done the right and proper thing by trying to make an "educated man" in "proper form" of the little Meeker boy, or would it have been better to "put him on one machine" (the slate) and let him be a specialist all his life? You did not the little Meeker boy? You can't answer? Well, neither can I. I believe in permitting the boy to follow his own bent, provided it is upward and will tend to elevate him. There has been many a smart lawyer and many an eloquent preacher lost on account of some darned thick-headed fool of a parent or big ignoramus of a foreman trying to produce a half-baked mechanic or specialist, and vice versa.

Suppose, John, that your boy goes to Cornell, and the professors find that he is somewhat dull in trigonometry, would you thank that institution very much if they should selfishly ignore his failing in this respect, and upon his return at the completion of his course, you would find they had sent a mentally crippled mechanical engineer in place of what you expected? Rather, would you not be better pleased if the management should send for you and say, "John, your son does not develop the natural desires needed to make a successful M. E., but tends more toward mercantile pursuits and finance? Hey?

In commercial lines of manufacture, I believe in "specialists." For instance, when I was running a basket works I had "nailers," "braiders," "banders," "feeders," etc., and the nailers could not do braiding nor did I expect the braiders to nail, but when I want a lot of carpenters to build the new addition, I will expect the man who puts down the floor and hangs the doors and windows to also be able to do the shingling or else I cannot pay him carpenter's wages. We don't want any "specialists" passing themselves off as mechanics and professionals. See?

We will try the boy, and if he does not show genuine love for mechanics at the end of four months, we will drop him and try some one else.

By the way, John, our friend Brook makes complaint because I didn't use the proper spirit when talking to that young man about washing his face at noon. As I simply told him "what I would *like* to see," and made no demands or requests, I don't exactly seem to catch the "spirit" that Mr. Brook refers to, unless he wants me to knock them down with a club first, and hold my conversation over the corpse, and I am sure there would be very little satisfaction in such a course for me and still less for the corpse. Some men don't seem to read English as it is spelled, neither do they take to a system of reason and kindness. He didn't seem to catch on to the fact that it was improved work that was "wanted."

Another thing, too, I want is that you keep this indicator and all the paraphernalia that belongs to it in the engine-room (it looks more in place there than here) and try and elevate the mechanical morals of your assistant there unless you find him lacking the necessary instincts. What? Is that the noon whistle? I did not think it so late.

What in the Sam Hill are those "cubs" all marching in this office for? Am I going to have a "strike" of apprentices, or is it going to be a "presentation" affair?

Well, I am glad John takes so well to his new position. He was a good engineer and had the right ideas regarding economy and improvement long before I came on the play, and while he isn't a prohibitionist," he doesn't approve of a "growler" around the place during working hours. That I like. THE OLD MAN.

CARE OF TOOLS.

The wooden parts of tools, such as the stocks of planes and handles of chisels, are often made to have a nice appearance by French polishing, but this adds nothing to their durabilily. A much better plan is to let them soak in linseed oil for week, and rub them with a cloth for a few minutes every day for a week or two. This produces a beautiful surface, and at the same time exerts a solidifying and preserving action on the wood.

The following recipes compiled by *The Tradesman*, are recommended for preventing rust on iron and steel surfaces.

1. Caoutchouc oil is said to have proved efficient in preventing rust, and to have been adopted by the German army. It only requires to be spread with a piece of flannel in a very thin layer over the metallic surface, and allowed to dry up. Such a coating will afford security against all atmospheric influences, and will not show any cracks under the microscope after a year's standing. To remove it the article has simply to be treated with caoutchouc oil again and washed again after 12 to 24 hours.

2. A solution of india rubber in benzine has been used for years as a coating for steel, iron, and lead, and has been found a simple means of keeping them from oxidizing. It can be easily applied with a brush, and is easily rubbed off. It should be made about the consistency of cream.

3. All steel articles can be perfectly preserved from rust by putting a lump of freshly burnt lime in the drawer or case in which they are kept. If the things are to be moved—as a gun in its case, for instance—put the lime in a muslin bag. This is especially valuable for specimens of iron when fractured, for in a moderately dry place the lime will not want renewing for many years, as it is capable of absorbing a large amount of moisture. Articles in use should be placed in a box nearly filled with thoroughly slacked lime. Before using them rub well with a woolen cloth.

The following mixture forms an excellent brown coating for preventing iron and steel from rust: Dissolve two parts crystalized iron chloride, two antimony chloride, and one tannin in four of water, and apply with sponge or rag, and let dry. Then another coat of paint is applied, and again another if necessary, until the color becomes dark as desired. When dry it is washed with water, allowed to dry again, and the surface polished with boiled linseed oil. The antimony chloride must be as nearly neutral as possible.

5. To keep tools from rusting, take half ounce camphor, dissolve in one pound melted lard; take off the scum, and mix in as much fine black lead (graphite) as will give it an iron color. Clean the tools and smear with this mixture. After 24 hours rub clean with a soft linen cloth. The tools will keep clean for months under ordinary circumstances.

6. Put one quart freshly slacked lime, half pound washing soda, half pound soft soap in a bucket and sufficient water to cover the articles; put in the tools as soon as possible after use, and wipe them up next morning, or let them remain until wanted.

7. Soft soap, with half its weight in pearl ash, one ounce of mixture in about one gallon boiling water, is in every-day use in most engineer's shops in the drip-cans used for turning long articles brought in wrought iron and steel. The work, though constantly moist, does not rust, and bright nuts are immersed in it for days till wanted, and retain their polish.

8. Mix slowly together six ounces or eight ounces lard to one ounce resin, stirring till cool; when it is semi-fluid it is ready for use. If too thick it may be further let down by coal oil or benzine. Rubbed on bright surfaces ever so thinly, it preserves the polish effectually, and may be readily rubbed off.

9. To protect metal from oxidation, polished iron or steel, for instance, the requisite is to exclude air and moisture from the actual metallic surface; therefore, polished tools are usually kept in wrappings of oil cloth and brown paper, and thus protected they will preserve a spotless face for an unlimited time. When these metals come to be of necessity exposed in being converted to use, it is necessary to protect them by means of some permanent dressing, and boiled linseed oil, which proves a lasting covering, as it dries on, is one of the best preservatives, if not the best. But in order to give it body it should be thickened by the addition of some pigment, and the very best, because the most congenial of pigments is the ground

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oxide of the same metal, or, in plain words, rusted iron, reduced to an impalpable powder, for the dressing of iron and steel, which thus forms the pigment or oxide paint.

10. Slack a piece of quicklime with just enough water to cause it to crumble in a covered pot, and while hot add tallow to it and work into paste, and use this to cover over bright work. It can be easily wipped off.

11. Olmstead's varnish is made by melting two ounces rezin in one pound fresh sweet lard, melting the resin first, and then adding the lard and mixing thoroughly. This is applied to the metal, which should be warm, if possible, and perfectly cleaned; it is afterwards rubbed off. This has been well proved and tested for many years, and is particularly well suited for planished and Russian iron surfaces, which a slight rust is apt to njure very seriously.

RUST REMOVERS.

1. Cover the metal with sweet oil, well rubbed in, and allow to tand for 48 hours; smear with oil applied freely with a feather or piece of cotton wool after rubbing the steel. Then rub with unslacked lime reduced o as fine a powder as possible.

2. Immerse the article to be cleaned for a few minutes, until all the dirt and rust is taken off, in a strong solution of potassium cyanide, say about one-half ounce in a wine glassful of water; take it out and clean it with a toothbrush with some paste composed of potassium cyanide, castile oap, whiting and water mixed into a paste of about a consistency of thick cream.

SHOP SUGGESTIONS.

The twist drill is put to some of the hardest usage of any tool in the shop, simply for the reason that a new drill can be found to take the place of the broken one, no matter how many times a break occurs during a job. We have seen a row of holes drilled as close together as possible, says the *Journal of Commerce*, and then an attempt made to break them all into one ong slot by tilting the work at an angle of 45° and drilling on a slant from one hole into the other. It takes but a moment to make a pair of jigs for his purpose, one for drilling the holes side by side for the first operation and the other to set in two adjoining holes while the intervening material s being removed with the drill.

Speaking of attempts, a queer case was spoken of a while ago, where an engineer was showing his fireman how to place a cap over the top of a metallic smokestack by the aid of two clothes-lines operated from the ground. The cap was to be made to do its own shinning up the stack by first pulling on one rope, then the other, though the stack had several guy ropes to hold it in a vertical position. The conical cover to keep out the rain could reach the top of the stack without any trouble, but to set it in place the fireman is still waiting for further instructions.

A chimney builder gives it as his opinion that a good hardwood wedge will lift as much as a jack screw. The wedge must be made of well seasoned oak, two feet long, with a taper of about one-fourth of an inch to he foot, and have one-half of its length on a good surface. By placing several of these wedges side by side, using a heavy sledge on one at a time, especially the one that starts the easiest, it is not to be wondered that a aking strain might be accomplished with wedges as well as with jack-crews.

In turning up a heavy screw, and boring out a nut to fit the end hreads, in both the nut and screw, will make trouble unless they have been eased off a trifle or removed entirely with a lathe tool. There is a hesitaion about a thread tool on entering the work and the same characteristic on emerging at the other end.

A heavy nut was being bored out about as heavy as could be clamped o the face plate, and when the size for the core of the screw was reached, thread tool was then set to work, and long before the full depth of the hread was cut the lathe carriage was allowed to run back for quite a disance and the screw hoisted with tackle and falls to be tested with chain ongs for a 6″ pipe; and when the nut got bored out at last sufficient for he screw to work, it was found that the cuttings left in the nut, together with the end thread imperfection, made a loose job of this proceeding. It much better to make use of the inside and outside calipers on such a job nd gauge the threads for every fit that is required and if a thread tool annot be found that will stand up to its work for the end threads, just make provisions to have an extra thread for this very purpose, to be removed when the thread cutting portion of the work is finished.

It is tiresome to see a slow-moving lathe running a thread tool back r another cut, when nearly half of the time could be saved by unlocking e lead screw and running the tool back by hand. This is always spoken f as risky business, altogether too risky for a lathe man who works by the ay, with the constant fear that a miscaught thread would be the means of king the cost of the job out of his pay. This should be done, however, r the lead screw can be locked in and tested at the end thread very easily fore the cut is allowed to take place and make almost as good a saving time, with no risk at all.

A leaky joint in a lead pipe, where the plumber with his assistant had led to get the soft solder to unite properly on the under side, was brought a close by a brass finisher who had turned a brass plug tapering at both ds, with a right and left-hand thread cut for this purpose. The plug was lled lengthwise for the water to pass through and screwed into both ds of the pipe at once, wired firmly with soft annealed wire wrung on h a bite taken around a stick, so tightly that the pipe must have been shed into the thread.

A NEW method of producing aluminum has been reported, and accord- to the discoverer, that metal will hereafter cost no more than copper. is same announcement has been made several times wsthin the past two three years, but still the price has not been reduced, as it was supposed t it would be. A company has been formed with $2,000,000 capital, and 500,000 plant is to be erected, having a capacity of 50 tons per y.

Practical Letters.

"The Old Man's" Critics.

EDITOR SCIENTIFIC MACHINIST:

I have noticed the letters, or "lectures," signed "Old Man," and the criticisms thereon in a recent issue. Now, Mr. Editor, I do not often write—I prefer to read what other men write. But I must say that I see little sense or justice in those criticisms. Mr. C. R. Brook thinks that "The Old Man" did not show the proper spirit in the matter of the young man washing his face. Does he think he showed a better spirit? Does not the tone of his remarks make his case worse than that he complains of? I think so.

Now, Mr. F. J. Meeker will please excuse me if I smile (I don't know how to do it in print) at his ideas and criticism. He wants specialists, and thinks that "The Old Man" errs in putting his apprentices through an all-around course in the shop. If there is anything more than another that makes the mechanical calling a series of vexations, it is the "specialists" we meet with in our everyday work. I want none of them, although I recognize that a man has a right to an opposite opinion. But I think if Mr. Meeker gives the subject much careful study he will not entertain his present opinion long.

C. C. ZARBE.

EDITOR SCIENTIFIC MACHINIST:

Anwsers to Messrs. Brook and Meeker.

I like "The Old Man's" lectures, and think Mr. Brook rather hasty in picking the old lad up in that face-washing business, as I don't think he has said anything out of the way yet. If Brook don't look out the *chairs* may be turned on him.

As to Mr. Meeker, he says if apprentices are not bright they should be kept at one thing until they become A No. 1. Now, what beats me is, how Mr. Meeker is going to find out which place the apprentice is going to be the best in without giving him a trial at everything. Some of the first-class mechanics will tell you they have spoiled enough work to start a little machine shop. Give the apprentice a show.

Go ahead, old lad, we are listening.

ONE WILLING TO LEARN.

An Oilless Cylinder—500 Pounds Boiler Pressure—About Apprentices.

EDITOR SCIENTIFIC MACHINIST:

During the last few days, I learned something I think will interest some of the SCIENTIFIC MACHINIST readers. A friend of mine, who is a fireman on the Erie railway, was telling me that in his rambles he met a stationary engineer who *said* he had run an engine (9″ bore) for 26 years without one drop of oil in the cylinder. My friend also said he had examined the engine and he could not find any place to get oil in. Now, Mr. Editor, this sounds to me like a fish story, but if any one can give us any light on this subject, they would be not only conferring a favor on the engineering fraternity, but also on those who own engines everywhere.

He also told me of a new boat, on Lake Chautauqua, that has a remarkable power plant. He said she carried 500 pounds pressure and that he saw the gauge register the same. His description was that the boiler is composed of tubes and that there is no safety-valve and that the water all returns from the engines. He said it was supposed to be non-explosive. I informed him I would rather be ashore than aboard of that boat. Of course, this is an advancing age, but I don't want anything to do with boilers with 500 pounds of steam and without any safety-valve attached.

I want to say a word or two in regard to the story, "A Set of Fine Tools." It has been very interesting to me, and especially where the foreman was going to discharge the boy, and the "super" interfered. It is too common practice in a great many shops now to put a boy on a machine and keep him at it as long as he will stay, and when his time is out he won't stay, and goes somewhere else, only to find out that he don't know anything at all but the one thing. Don't discharge a man just because he cannot do the first job you put him at, but try him at something else.

J. E. J.

Conjectures Concerning a Disappearance.

EDITOR SCIENTIFIC MACHINIST:

Some of the boys were talking over mechanical matters at the news store, a few evenings ago. Of course the SCIENTIFIC MACHINIST came in for its share of comment. There was one thing in particular suggested that I thought I would write to you about. We were all disappointed for the second time in not finding the story "A Set of Fine Tools," in the paper. Various were the conjectures as to what could be the cause of its stopping off so short. Finally one of the boys recollected that it was written by one Wm. Harrison, and he at once came to the conclusion that the author must be a relative of Ben Harrison. This supposition accounts for the breaking off of the tale, and is, therefore, the most reasonable one we could think of. Now, if that is the correct solution, Mr. Wm. Harrison may resume his literary labor, for his "grandfather's hat" is again nominated O. K., giving him leisure to turn his attention from the *machine* to the MACHINIST.

ALBERT DURAND, Jackson, Mich.

THE Lodge & Davis Machine Tool Co., Cincinnati, desire to acknowledge a visit from Prof. J. J. Flather, Ph. B., professor of mechanical engineering, Purdue University, Lafayette, Ind., and the following students of the Senior class: Messrs. V. R. Browning, T. M. Gardner, A. O. Greeson, A. J. Herzog, Jr., H. M. Lane, G. Parks, F. C. Scheuch, R. A. Smart and A. L. Westcott. They occupied the morning inspecting the works, and examining into the mode of building machine tools, especially the many special jigs, and attachments for producing duplicate work.

SCIENTIFIC MACHINIST

Formerly, WESTERN MACHINIST.

DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES.
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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, JULY 1, 1892.

☛**The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.**

THE AGE OF IRON WORKERS.

Many people now living can well remember when wooden rails were used for railway track. Similar to this trial of wood was the wooden lathe operated by foot power. Twenty-five years ago "structural steel," as applied to building, was unknown. It may be said that wooden structures are fast following in the wake of wooden machinery, and being supplanted by iron, steel and stone. As cereals were once ground by a wooden ladle in a mortar hollowed from the stump of a fallen tree, and is now done with iron rollers at lightning speed; so buildings, once made squatty with flimsy timber frames, are now run up to 20 stories with perfect safety on steel posts and girders. What shall we say, moreover, of the change from wood to iron for cars, from wood to steel for barges, and a like change in a hundred other articles of such general use?

But let structure material in use be whatever it may, wood, iron or stone, the machinery for working and handling these materials we have learned by experience to make principally of iron. We have, therefore, a constantly increasing demand for iron workers of various kinds. No steam power, no pneumatic power, no electric power can be applied without iron receptacles or iron conductors. A science of the strength and use of iron in mechanical engineering becomes one of the most important subjects for the great mass of the people of this iron age.

We therefore favor any addition to our public school system which shall include more primary instruction upon this subject. And we hope to see ere long the elements of mechanical engineering taught in our schools as a common branch.

THIRST FOR KNOWLEDGE.

J. F. Harrison, Superintendent of the National Screw & Tack Works, of Cleveland, declares that he can easily tell who among his workmen are habitual readers of mechanical literature by the manner in which they work. Mr. Harrison does not claim to have a secret, but a general rule which all may profit by. Any one can tell a reader by his careful, deliberate manner of working. The studious workman aims to reach the highest rung in the ladder. He works not in a slovenly, reckless way as though he did not care for anything but the pay; but he works as an artist who sees in his work a marvel of beauty and interest and an inexhaustible storehouse of research before him.

There are some men who make mechanism a life study. These are always readers of the books and papers on mechanism. And these are the men who become foremen and superintendents of manufactories, and leaders of the world in the industrial arts and sciences.

THE SCIENTIFIC MACHINIST, with this issue, finishes the first half of the eleventh year of its existence, and completes one year under its present name. We have abundant reason to feel that our efforts to make a practical paper for practical men, at a price within the reach of the poorest mechanic, have been appreciated.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(387.) A. B. McCarty, Rockoak, W. Va., asks: "Kindly tell us how to set an eccentric on a 60 H. P. engine, with plain side slide valves, also state how the lead is given and how much it should be to run an engine properly with as little steam as possible." *A.*—Place the engine on the dead centre and move eccentric around in the direction the engine is to run, until the steam valve is open 1-16". Then set the engine on the opposite centre and see if the valve opens the same at that end. It not, you must lengthen or shorten the eccentric rod until the valve travels the same distance both ways.

(388.) Chas. Boetcher, Bloomville, O., writes: "In order to settle a dispute, please state in your next issue who is right in regard to the following points. Friend L. claims that a pump in a well, say, 100 ft. deep, with 3" cylinder and 1½" discharge pipe (sucker rods to be placed and worked inside of discharge pipe) will work much easier than a like, or same pump, under the same conditions, but with a 3" discharge pipe instead of the 1½" discharge. I claim that if there is any difference, it is in favor of the pump with the large discharge pipe. 2. He also claims that any pump set with its cylinder, say, 20 feet above the surface of the water, will work much easier than a like, or same pump under the same conditions, except that the cylinder must be about submerged instead of being elevated above the surface of the water. I claim there is no difference as to the ease of operation, but that the pump with the submerged cylinder will work more satisfactorily as a general thing, than the pump with the elevated cylinder if the valves become leaky in both cases." *A.*—You are right.

(389.) M. D., Harrisburg, Pa., writes: "A friend and I have had a dispute over the following question: Can an electric lighting company have a man imprisoned or fined who taps their wires for current, without their consent? Kindly answer through 'Question and Answers' in your next issue." *A.*—Such an offense should be punished, the same as cutting a channel into the race that supplies water to a mill and conveying away the motive power upon which the business depends. If the laws of Pennsylvania, or any other State, do not prevent such a theft or protect the owners of electric plants in the preservation of their product, which is this current, from despoliation, they need amending very much.

(390.) E. E. Williamson, Perry, Ia., writes: "Please let me know where I can get a water motor, also a dynamo and electrical outfit. Can I run an electric machine with a water motor and successfully light the building?" *A.*—You can furnish the power necessary to run a dynamo with a water motor, if there is force or pressure enough. You will see the advertisement of one or more electrical companies in our columns. Write to them for information concerning electrical outfits, lamps, wire, dynamos, etc. Following is a list of manufacturers of water motors: Pelton Water Wheel Co., 121 Main street, San Francisco, Cal.; Knight & Co., Silver Creek, Cal.; Dayton Globe Iron Works, Dayton, O.; The Jas. Leffel & Co., Sprinfield, O., and J. K. Firth, 223 1st street, San Francisco, Cal.

(391.) Geo. Hines, Oneida, N. Y., asks: "Could you please b so kind as to inform me how to lay out gears, and also how to cut thread without an index on the lathe?" *A.*—Divide the pitch to be cut by pitc of the feed screw and the product is the proportional number. Then multiply the number of teeth on the mandrel gear by the number of teeth o the smaller gear of the compound pair, and the product by the proportional number, and divide the last product by the number of teeth in th larger compound gear, and the quotient will be teeth in gear on feed screw.

(392.) D. P. A., Akron, O., writes: "What is the value of stea compared with water?" *A.*—Water, when converted into steam, increas in bulk, 1,728 times.

(393.) John Loring, Baltimore, Md., writes: "I have read som thing about a sledge hammer falling as rapidly as a thistle-down. Now, don't understand that. I notice that a brick from a wall where masons a working falls quicker than a shingle dropped at the same time. Plea explain." *A.*—When not arrested by the air, the descent of a thistle see which is the lightest substance that can easily be seen in its flight throu the atmosphere, will fall as rapidly as a sledge hammer or a piece of lea The only conditions under which this can be observed and tested are pump the air from a high tube, or barrel, and drop two articles of differe gravity, such as a feather and a piece of lead, simultaneously. It will seen that the feather will reach the bottom as quickly as the piece of lea There are glass tubes made to demonstrate this fact in natural philosoph

(394.) D. H. McC., Pembroke, Canada, asks: "Would you kind inform me in your next number as to how I can make 'dry batteries'? *A.*—This information should come from experts. We can answer que tions on electrical construction, but as there are books on these subjects p pared at greater expense than we could devote to answers in this colum and which are generally cheap, we refer all who wish to procure directio and instructions for making electrical apparatus to the electrical journa Nearly every one has a list of electrical books comprising the most reliab published, on all these subjects, and will be pleased to mail a sample co containing such a list to any address. Send to the *Western Electrician*, Lakeside Building, Chicago, Ill.; *The Electrical Review*, 13 Park Ro

N. Y.; the *Electrical World*, Times Building, N. Y., or any of the various other reliable journals on the electrical science.

(395.) L. E. Bates, Birmingham, Ala., writes: "I noticed an advertisement in your paper about a catalogue of tools that was very complete, and was sent for $1, the money being refunded when $10 worth of goods were bought. Now, Mr. Editor, my wife can not find it, and I have sore eyes so I can not read. I would like to ask you if it is a publishing house, or a manufacturing house, and what they offer. *A.*—You probably refer to the very excellent and liberal offer of Montgomery & Co., 105 Fulton street, N. Y., to send their catalogue of over 700 pages, bound in cloth, for $1, express charges paid (no matter to what part of the country it goes), and to credit the amount paid for it on any bill of tools, bought by the buyer of the catalogue, amounting to $10 or over. The firm is not a publishing house, but the largest dealers in machinery and supplies in New York City. The advertisement is on the 15th page. The offer should be read by all.

☞ Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

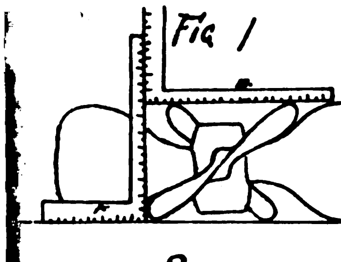
HOW TO MEASURE THE PITCH OF A SCREW WHEEL.

BY J. A. MORGAN.

I am often asked how to measure the pitch of a screw wheel. I have, in this article, given the different ways by which readers of the Scientific Machinist can measure any wheel they may wish to.

Referring to Fig. 1, when the wheel is lying flat, take two carpenter's squares and place them as shown, letting A rest on the ground, touching the edge of blade, and B placed against A as shown, touching the top edge of blade. This will give the pitch for a portion of a revolution or circumference of the wheel, measuring at extreme end of blade. Suppose the wheel was 50" in diameter and that square A from the ground or from the edge of the wheel on the ground, if it touches the ground, to square B, measured 10", and from the edge of blade to square A on square B measured 10", this would show that the wheel was 10" pitch, for 10" of the circumference, and as a 50" wheel is 157" in circumference, 10" would be 15.7 of the pitch, which multiplied by the pitch for 10" would be the whole pitch of the wheel which, in this case, is 157".

The pitch should be measured at different parts of the blade, for an average, always figuring the circumference at the point measured. As if you wanted to get the pitch 5" from tip of blade, the circumference should be taken at 40" diameter of the wheel. I think this is the easiest method where a wheel is lying on the ground, and is not too large for the squares.



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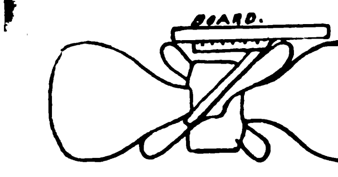


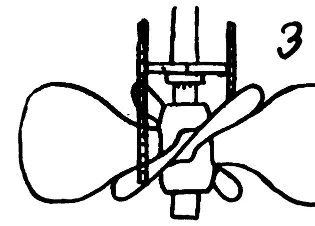


Fig 4.

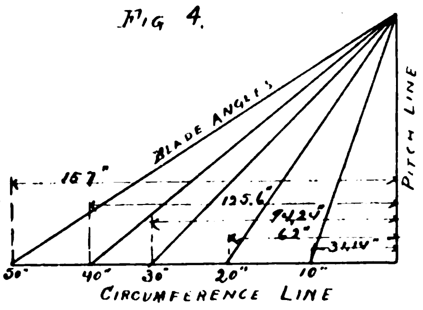


Fig 5

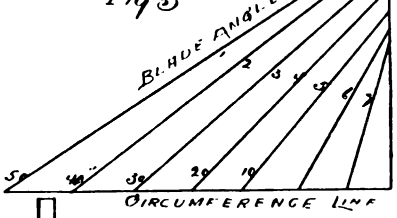
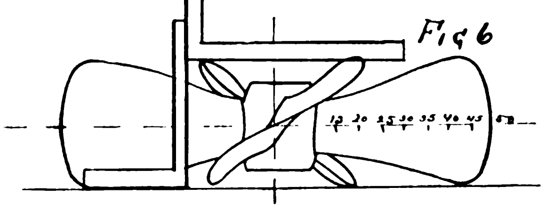


Fig 6



Another way is shown in Fig. 2. All there is to do here is to draw a line (as in Figs. 4 and 5) from a scale representing the different circumferences at the different points measured, and then get a bevel and place a board across the hub of the wheel and get the angle of the blade at different points, and draw lines (as in Figs. 4 and 5). Nos. 1, 2, 3, 4, etc., represent the different angles, and where they intersect, a line drawn perpendicularly to the circumference line, will be the pitch. If, as in Fig. 4, the angle lines all come together, showing that the pitch is the same at all points of the blade, the screw is a true screw. But, if the angles are different, or pitch is different at different points, as in Fig. 5, the average pitch must be taken. If the pitch is greater at the tip of blade than at hub, the wheel is expanding pitch, and if less at tip of blade than at hub the wheel is decreasing pitch, each of which can be found when measuring the wheel.

Sometimes a wheel is very large and is on the shaft on the boat and cannot be measured by the two first methods. In a case of that kind, take a stick and fasten it on the shaft so that it can be turned around parallel with the wheel, or right angles to the shaft. Then divide shaft on its circumference into any number of equal parts, say 10, then place the stick at one of these marks and measure from stick to blade (as in Fig. 3). Suppose it was 4", then move the stick to another mark (which will be $\frac{1}{10}$ of the circumference) and measure again; and, supposing it measured 24", it will be seen that the wheel is 20" pitch for $\frac{1}{10}$" of a revolution. And if wheel is 100" in circumference 100 ÷ 10 would be that part of the circumference that $\frac{1}{10}$ of revolution is, which will be 10"; and 20" pitch in $\frac{1}{10}$ revolution and will make the wheel 200" pitch.

It must be remembered that whatever part of the blade is measured the circumference must be measured from that point, as in Fig. 6, where the 50" wheel is measured, the marks showing the different points at which wheel was measured, and also the different diameters at these points. The circumference should be figured from them, Fig. 4, showing the different circumferences at different diameters.

THE MUELLER LATHE.

The Mueller lathe, illustrated on first page, has a wide reputation for efficiency. It is designed with special reference to the varied and severe duties that modern shop practice imposes on machine tools. It is equally well adapted to the handling of either light or heavy work in a convenient and accurate manner. The most approved methods are used in fitting up the bearing surfaces of the working parts, which are made from carefully selected material, best suited to their respective purposes. The spindle is made of an extra quality of hard hammered steel. It runs in hard bronze boxes of such form as to retain perfect alignment after considerable wear. These boxes can be easily duplicated. The back gears are so proportioned as to give regular gradations of speeds from the slowest to the fastest. The carriage has solid bearings on V's its entire length, and is gibbed full length to outside of bed.

An inspection of the cut will explain the patented feed arrangement which admits of driving feeds with either belt or gearing without the necessity of disconnecting either. All screws and small gears are made of steel, and all gears are cut from the solid. Lathes are furnished with plain tool rest, power cross feed, screw cutting apparatus, center rest, follow rest, large and small face plates, counter-shaft and wrenches complete. Compound rest, independent rest or improved taper attachment added if desired. Beds of any desired length can be furnished. The counter-shaft has patented friction pulleys, of a size in proportion to the tool. Every lathe is carefully tested before leaving the works, and their accuracy and the quality of the workmanship is equal to the best.

This lathe is made in various sizes, by the Bradford Mill Co., 8th and Evans streets, Cincinnati, O. A very interesting and more detailed description can be procured free by simply dropping them a card.

A MOTOR GEAR LATHE.

On the first page we present an illustration of an interesting and entirely new machine designed for motor gear work. It was invented for the special purpose of obtaining higher duty than is possible from an engine lathe. It is very rigid. This machine overcomes the obstacles met in turning large diameters suspended between centers. It is also well adapted to the furnishing of pulleys and to many kinds of boring.

The two saddles carrying the tools may be used as box tools are now used for large work, and their great rigidity, and the fact of cutting on both sides at once will produce diameters, either straight or taper, with heavy mushet steel tools that require regrinding but once a day on account of the great amount of metal backing up the cutting edges, the tools intended to be used being ¾ x 1½" steel. Care has been taken to incorporate all the power and stiffness such a machine requires. It has a 26-inch swing and has three times the power of a 26-inch engine lathe. The bed is cast all in one piece, from the floor to the center of the spindle bearings. The slides upon which the saddles move, are also part of the bed. The feeds for saddles and boring slide are obtained from main driving shaft with worms and frictions, and are very substantial.

A better description, with additional illustrations, can be obtained by addressing such a request to The Ohio Machine Co., Cincinnati, O., who are the builders.

We take pleasure in calling the attention of readers to the new series, under the head "Amateur and Apprentice," begun in this number. This work is from the pen of Mr. Edwin Woodward, whose articles on "Bolts and Screw Threads," and "Hints to Engineers," in the Scientific Machinist, have been highly appreciated. Mr. Woodward's versatility and experience render his mechanical writings no less profitable than pleasant to read.

The twelfth annual convention of Boiler Makers was held in Cleveland during June, at which was present T. J. Curran of New York, the international president; William Gilthorpe, the international secretary, and delegates from Mexico and Canada. The organization now numbers 74 local assemblies with a total membership of 40,000.

Burlington Route New Service.

A through Pullman sleeping car Chicago to San Francisco is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11 45 A. M., less than four days en route.

THE NEW LICENSE LAW OF BUFFALO.

The new law which has just gone into force in Buffalo, providing for the examination of engineers and the inspection of boilers, is as follows:

ARTICLE I.

SECTION 1. There is hereby created the office of Inspector of Steam Boilers, who shall hold office for the term of three years, unless sooner removed for cause, and until his successor shall be appointed and qualified. Said inspector shall be a practical boiler maker.

SEC. 2. He shall be appointed by the mayor on the first Monday in January, 1892, or as soon thereafter as may be, and every three years thereafter.

SEC. 3. Said inspector, before entering upon the duties of his office, shall execute a bond to the city of Buflalo in the sum of $5,000 with two or more sureties, to be approved by the mayor, and conditioned for the faithful performance of the duties of his office.

SEC. 4. The person so appointed shall be a person well qualified from practical experience in the use and construction of boilers used for generating steam for power, steaming or heating purposes, to enable him to judge of their safety for use as such, and shall be neither directly nor indirectly interested in the manufacture, ownership or agency of steam boilers which are to be inspected.

SEC. 5. It shall be the duty of the inspector to inspect once in each year all boilers used for the generating of steam power or for heating or steaming purposes, and all tanks subjected to steam pressure used in any business, except such boilers and tanks as shall have been inspected and insured by some duly authorized insurance company within six months of the time the inspector shall offer to inspect the same, by making a careful examination of, and subjecting the same to a hydrostatic pressure, which shall exceed the maximum working pressure in the ratio of 150 to 100 pounds, and in no case working pressure to be more than 100 pounds per square inch for a new boiler 48″ in diameter, made of No. 1 iron plates of ¼″ in thickness, and the steam pressure of all boilers, whether thicker or thinner, larger or smaller, than above mentioned in this section, shall be governed by the same standard of strength.

SEC. 6. When an inspection of a boiler has been made, and the same shall be approved by the inspector, he shall make and deliver to the person for whom the inspection was made, upon the payment to him of the fees hereinafter mentioned, a certificate of such inspection, which shall contain the date of inspection, together with a general description of such boiler, for what purpose used, the number of try-cocks, steam and water gauges, pumps, the number of pounds pressure at which said boiler had been tested, and the maximum pressure at which they may be safely used, which shall be framed and put up in the office or some other conspicuous place on the premises for examination, and a record of the same shall be made by the said inspector in a well-bound book and alphabetically indexed.

SEC. 7. It shall be the duty of said inspector, on written application of the owner or agent of any boiler, generator or superheater, stating that the same is out of repair, or has been repaired, to examine the same when so repaired, and determine if the same has been properly done.

SEC. 8. The said inspector may charge a fee of $3 for inspecting each boiler, which shall be paid by the party owning such boiler before the delivery of such certificate, excepting that in any establishment where more than one boiler is used, said inspector shall only be entitled to such fee of $3 upon one boiler, and a fee of $1 upon each and every additional boiler. The inspector shall pay all fees collected by him into the City Treasury, on or before the fifth day of each month, and his failure so to do shall be sufficient cause for his removal.

SEC. 9. If the inspector shall take or receive any money other than the fees allowed by this ordinance for the purpose of deceiving or defrauding any person or persons; or if such inspector shall issue any certificate of inspection without having at the time stated thoroughly examined and tested the boiler so certified for, he shall be fined in the penal sum of not more than $250, and shall be removed from his office by the mayor, and shall ever after be incompetent to hold the same.

SEC. 10. The city of Buffalo shall provide such instruments, books, papers and things as shall be necessary for the proper performance of his duties as inspector, to his successor in office, or to the Commissioner of Public Works, whenever he shall cease for any cause to discharge the duties of his office. And said inspector shall also, without expense or charge, inspect all boilers owned or used by the city, or any of its departments, whenever called upon by the proper officer. He shall also report to the Common Council every three months, or as often as once a month if required by said council, all inspection of boilers by him made.

ARTICLE II.

SEC. 11. It shall be the duty of every owner or other person using steam boilers, or any tank or tanks subject to steam pressure in this city, to have the same inspected by the inspector of boilers as often as once in each and every year, and to that end every owner or person using a steam boiler or tank aforesaid, shall make or cause to be made annually, an application in writing to the inspector requesting him to inspect the same. Provided, however, that any person or owner using such tank or boiler, who shall have had the same inspected and insured by some duly authorized insurance company within six months of the time the inspector may offer to inspect the same, shall not be required to comply with this ordinance.

SEC. 12. It shall be the duty of every owner or other person using steam boilers in the city of Buffalo, to provide and fix thereto, a full complement of try-cocks, one water gauge, one steam gauge, and one or more safety valves of suitable dimensions to be approved by said inspector. Also a good and sufficient force pump or other means of supplying the boiler with water, which shall also be subject to the approval of said inspector.

SEC. 13. All owners or persons using steam boilers and tanks subject to inspection as aforesaid, shall provide at their own expense such arrangements and facilities for attaching the instruments for inspection, as the inspector shall direct.

SEC. 15. The safety valves of steam boilers shall not be allowed to extend beyond the maximum pressure allowed by said inspector.

SEC. 16. Any person who shall violate any of the provisions of this chapter, where no other penalty is provided, shall be subject to the penalty of not less than $20 nor more than $100 for each and every offense.

SEC. 17. It shall be the duty of the inspector on or before the fifth day of each month, to file with the City Comptroller a statement under oath, showing the names of owners of boilers alphabetically arranged, whose boilers have been inspected by him during the previous month, the location of said boilers, the date of inspection, and the amount of money received by him, and from whom received for inspection during such previous month.

ARTICLE III.

SEC. 18. There is hereby created the office of examiner of stationary engineers, who shall be appointed by the mayor on the first Monday in January, 1892, or as soon thereafter as may be, and thereafter, at any time the office may become vacant.

Said examiner shall be a citizen of the United States, and shall have not less than ten year's practical experience as a stationary engineer, and shall hold office until his successor shall be appointed and qualified.

SEC. 19. It shall be the duty of the examiner to make such rules and regulations as shall be necessary to properly carry into effect the provisions of this ordinance. He shall keep a record of the transactions of his office, and shall render annually, before the first day of January, a report of the same to the mayor.

It shall be his duty to give proper notice of the time when and place where he shall examine all persons who shall appear before him for examination, as to their qualifications to operate and have charge of steam engines and boilers in this city, and he shall issue a license to applicants as this ordinance provides.

SEC. 20. Every person within the city limits of the city of Buffalo, in charge of or operating any steam engine or steam boiler, except persons operating locomotive steam engines, or persons duly licensed by the United States authorities, shall appear in person before the examiner, within 90 days after the passing of this ordinance, for examination as to his qualifications as a stationary engineer, and if found qualified, shall be duly licensed as this ordinance provides.

SEC. 21. No person shall be granted a license unless he be an actual resident of the city of Buffalo, and shall be a citizen or shall have declared his intention to become a citizen of the United States.

SEC 22. Any person found in charge of, or operating any steam engine or steam boiler, in a state of intoxication, shall forfeit his license for any term not less than six months, and it shall be the duty of the examiner to cancel or revoke the license of any person licensed under the provision of this ordinance, who shall be found incompetent or negligent in the performance of his duty as an engineer.

SEC. 23. Any owner, agent or user of any steam boiler, in operation, who neglects or refuses to employ a licensed engineer, to have charge of or operate said steam engine or steam boiler, shall forfeit and pay a penalty of not less than $10 or more than $250 for each offense.

SEC. 24. Any person taking charge of or operating any steam engine or boiler within the city of Buffalo, without having a proper license, shall forfeit and pay a penalty of not less than $10 or more than $50.

SEC. 25. All license must be renewed annually, and no person shall have charge of or operate more than one steam plant.

SEC. 26. A fee of $3 shall be collected by the examiner upon issuing a license, and $2 for each annual renewal, and all fees collected shall be paid by the examiner to the City Treasurer, on or before the fifth day of each month, and his failure to do so shall be a sufficient cause for his removal. The examiner shall also report to the Common Council every three months, of oftener if required, the number of licenses issued, and the amount of fees collected by him.

SEC. 27. All persons licensed under the provisions of this ordinance shall be classified and graded according to the capacity or horse-power of a steam engine, steam boiler or steam plant, of which they shall be competent to take charge, namely: Chief engineers, first-class engineers, second-class engineers and special engineers.

Chief engineers to take charge of and operate any size steam plant. First-class engineers to take charge of any steam plant not exceeding 150 horse-power, and second-class engineers to take charge of and operate any size steam plant not exceeding 75 horse-power, and special engineer to take charge of only a certain steam engine or boiler to be stated in the license, such steam engines or boilers not to exceed 10 horse-power, and such license not to be used for a longer term than one year.

SEC. 28. Steam boilers used in private dwellings only for heating or cooking purposes, where the water returns automatically to the boiler without the aid of a pump, injector or inspirator, are exempt from the provisions of this ordinance.

SEC. 29. Engineers duly licensed under the provisions of this ordinance, shall have their license suitably framed, under glass, and hung up in a conspicuous place, at or near their engine or boiler.

A New Method of Hauling Logs.

An ingenious method of inclined and horizontal log hauling has been introduced, very successfully, at the Hudson River paper pulp mills. The arrangement consists of an endless detached chain, running in a recess at the bottom of a trough, having special links with log teeth every 5 feet, and passing over sprocket wheels whose centers are 200 feet apart; the head wheel is 25 feet above the foot wheel, and the head end of the chain swings, and can be raised or lowered by means of a small winch to suit the depth of the water. The logs are floated to the haul-up, and, as they come around the foot wheel, are caught on the teeth of the chain and carried up the incline at the rate of 125 feet a minute. On arriving at the top they are discharged into a horizontal log-haul, having head and foot wheels nearly 600 feet apart, the whole thing being similarly constructed to the inclined haul—the return chain supported by toothed idlers—and a deflecting piece is placed across the horizontal conveyer, by which the logs, elevated by the chain, are thrown out of the trough and rolled over the side upon long skids. By this arrangement the use of eight or ten double teams and as many men is dispensed with. Some of the logs measure 30" in diameter and 50 feet in length, and a 25 horse-power engine is found ample for this purpose.

SILICON IN FOUNDRY MIXTURES.

BY W. J. KEEP.

Thin castings for light hardware and for stoves must be soft and gray, and must have as little tendency to chill as possible.

The chilling tendency which some irons possess seems to be independent of chemical constitution, and was imparted to the iron in the blast furnace.

In such irons some peculiar relation seems to exist between the silicon and the carbon, which causes the iron to be white, if suddenly changed from a liquid to a solid.

Some ores produce a chilling cast-iron, and when smelted with charcoal such tendency is increased.

When the iron has been made with a tendency to chill, such peculiarity cannot be removed, though it may be partially overcome for the time being.

Therefore, for stove plate castings, such chilling irons should not be used, and in making purchases it should be stipulated that the pig iron bought shall make castings free from chill when such pig iron is melted in a crucible under proper conditions.

In this case, prevention of chill is worth much more than any partial cure.

Phosphorus and manganese in the quantities usually found in pig iron have practically no influence upon the iron, and do not influence chill.

The grayness of thin castings is entirely caused by the carbon and the silicon in the iron. The presence of either one without the other will cause the casting to be perfectly white and extremely hard. Pig iron will not contain more than 4 per cent. of carbon.

The presence of silicon separates some of the carbon from the iron just as it solidifies, and it is the imprisoned particles of carbon that are caught in the mass, that give color to the iron.

Without silicon the iron could not be gray, but would always be white. Silicon then is a necessity in gray cast iron. From 2½ per cent. of silicon to 3 per cent. will give the best results for very thin castings. The open gray foundry irons used for thin castings will contain about this quantity.

Molten white iron is thickly liquid, and fluidity is given to melted iron by so influencing carbon that, when the iron cools, a portion will change into graphite. The larger the percentage of graphite after the iron is solid, the more fluid will the iron be while molten, and before the graphite separates.

As silicon is the agent which causes the formation of graphite, it is silicon which causes cast iron to be fluid. It has been said that phosphorus causes iron to be fluid. It does cause it to remain fluid some longer, but probably does not make it more fluid.

Pig iron is produced in the blast furnace with more or less shrinkage, which is independent of chemical constitution. Therefore, selecting iron that will produce castings with small shrinkage is the best method for reducing shrinkage.

Graphite is very bulky, and as it separates in the iron after the iron is in the mold, and at the instant the iron becomes solid, it takes up more room, and the castings are larger according as the quality of graphite is increased. Silicon is the sole cause for the formation of graphite, therefore silicon reduces shrinkage. Fluidity and lessening of shrinkage will cause the edges of a casting to be sharp; silicon therefore makes perfect castings.

If an iron has a tendency to chill, by increasing silicon the depth of chill may be decreased while the silicon remains in the iron, but if the silicon is again diminished the chill will return; therefore we say that silicon reduces chill.

White iron is brittle, while gray iron is somewhat ductile; therefore silicon adds ductility to cast iron.

Gray iron is softer than white iron; therefore silicon by making iron gray, softens cast iron; hence the name of softener for silicon iron.

If pig irons are used in such proportions as to give about 3 per cent. of silicon, and are melted in a cupola furnace in contact with the fuel, considerable of the silicon will be driven out of the iron, and the castings will not contain as much as the pig metal.

Sulphur will cause silicon to leave molten iron, and as all fuel contains some sulphur, the melting of iron will reduce the silicon that it contained while in the pig.

Sulphur is not evenly distributed throughout the fuel, and cannot be distinguished by the eye; therefore, any carload of fuel may contain more sulphur than was expected, and the result will be an increased expulsion of silicon, and consequently close-grained, hard, light-colored castings.

In every-day practice we can only know the presence of sulphur in the fuel by the results, and such knowledge comes after the fuel is burned, and therefore it cannot be guarded against. The sulphur does not stay in the casting. It does the harm and passes out of the stack. The blast of air also burns out some of the silicon. As next day a considerable portion of this close-grained iron must be returned to the cupola, the closeness and hardness is increased as the silicon is diminished.

To make a mixture of iron for light castings, and run a cupola which shall produce a uniform soft gray product, is simply a question of keeping the silicon up to between 2½ and 3 per cent. of the mixture.

It makes little difference where we obtain the silicon, if we only get in enough to keep up the percentage. If we admire dark castings and a dark open grain, it is best to use a large quantity of dark open-grained pig.

The reason for this is, that each time the iron solidifies, the silicon drives some of the carbon entirely out of the iron, and repeated re-meltings therefore reduce the carbon as well as the silicon, and, as the dark color came from the carbon, its expulsion causes the castings to be lighter in color.

The only way to remove carbon and silicon at the same time is to use plenty of No. 1 pig iron, but as this rarely contains more than 3½ per cent. of silicon, it will be impossible in this way to increase silicon rapidly, and if a second dose of sulphur should follow the first, it might be difficult to soften the castings quick enough to prevent loss.

No. 1 pig iron, especially that which is dark-grained, is expensive, and while it is a fact that the more carbon there is present, the less silicon will be required to produce a given grain, yet additions of silicon by the increase of No. 1 iron will, in any case, be expensive, and will need very close attention.

We might call the adding of silicon and of new graphite carbon by means of No. 1 pig iron the natural way to produce gray castings.

The other way, which may be called the artificial method, is to purchase irons that can be bought most cheaply, and bring up the silicon by additions of silicon pig. This will turn the carbon of the iron into graphite and make cheap, hard irons, soft and gray. This method will produce close-grained castings, light in fracture, but strong and soft. If there is sulphur in the fuel to lessen the silicon, an increase of silicon pig will restore the silicon at once.

In this way with cheap irons, which are easily procurable, as good castings can be made as with higher priced No. 1 iron.

This method has some other advantages. This adding of silicon to the melted iron artificially forms graphite after the iron has entered the mold, and just as the iron solidifies. The graphite which reaches the surface of the casting forms a facing between the iron and the sand of the mold, which is more effective than facing shaken on, and gives the casting a glistening silvery surface.

The reason for the grain being closer, and the carbon being diminished, is that high silicon iron contains less carbon than No. 1 or No. 2 gray foundry iron, and, therefore, at each addition the carbon will become less, and the castings will become lighter in color.

Before closing, let us say a word regarding silicon pig iron. As silicon drives out carbon, the higher the silicon the less the grain in a pig iron or casting. Pig iron containing 10 per cent. of silicon has very little grain, and with 15 per cent. the grain is generally absent, the high silicon irons are often full of blow-holes. Pig iron with from 4 to 6 per cent. of silicon can be produced at ordinary blast furnace temperatures from suitable ores, but to obtain the higher percentages a furnace must be run at an unsafe temperature.

The high grades are therefore more expensive, and being deficient in carbon, are no better for use than the lower grades, which are more easily and cheaply obtainable.

As to the kind of silicon iron to use, it makes but little difference where the silicon comes from. One iron is about as good as another, if the same rules regarding chill and shrinkage are observed as are applied in the purchase of gray pig. Very high silicon irons will often give quite a deep chill, and must, therefore, be avoided. The location of the foundry will determine what irons are most desirable to purchase, and it will take some experiment to find out which irons will go best together.

We sometimes hear of some one who does not believe in the use of silicon iron, or who has not produced good results by its use.

It must always be remembered that for soft gray castings as thin as stove plate, the silicon should be about 2¾ per cent.

If your castings already contain that amount, it will result in damage to make it higher.

The only place to use silicon iron is in a mixture deficient in silicon.

For machinery castings, which should contain about 1½ per cent. of silicon, mottled and low grades of gray foundry pig iron may be used, and if more silicon is needed, a little No. 2 or No. 1 may be added, it being an easy matter to keep up the silicon, or very close gray, and even white pig iron and burned scrap may be used, if the required percentage of silicon is restored by additions of No. 1 pig, or by silicon pig iron.

A difference of opinion exists as to the number of brands of pig iron to be used at one time. It is impossible to run a blast furnace regularly. The silicon varies considerable in the pigs made from one cast, and a furnace is likely to go wrong at any time. It is impossible to refuse iron made at such times, if it were possible to determine when the iron was not such as was purchased. It is therefore best to use a variety of makes of pig iron in making up a mixture; the greater the variety the better. Then any temporary variation in one or two of the irons will not materially influence the castings.

It is sometimes claimed by the blast furnace manager that it is better for him to make a proper mixture of ores in the furnace, so as to produce exactly the iron desired, and sell the iron on a guaranteed analysis, and not trust to the foundryman's judgment as to what a mixture should be. It would be a good idea for all furnace men to produce this kind of iron if they are able to do so, but as their furnace may go back on them several times in a week, it is better to have several brands of such irons mixed together, for the reasons just given. If any variation should then occur to influence the castings, a small addition of silicon pig will set all right at once.

[The foregoing paper was read before the National Association of Stove Manufacturers at Chicago, May 4.—ED.]

AMATEUR AND APPRENTICE.—I.

A SERIES ON ELEMENTARY MECHANICS.

BY EDWIN WOODWARD.

The marvelous advancement made in mechanics in the last double decade when viewed in all its bearings, is truly wonderful. Then the box of tools, the scroll-saw, the foot lathe or what is now termed an amateur outfit, was a thing dreamed of, thought of and talked of by the enterprising lad, but seldom possessed, for the manufacturers, then, had no thought of catering to the desires of the less wealthy class, and none but expensive machines were to be had, and since customers were limited to the wealthy, sales were few, for while the ingenuity of the rich boy is equal to that of the poor, the incentives to develop it usually are wanting—the professions, liberal arts, or sciences tempting the feet into less arduous paths.

But occasionally an outfit was bought and the favored youth would set it up in his "den" and with magnificent energy its wonderful capabilities would be brought into requisition for a season of time—at least till the novelty of it wore away—to be used after—if ever—in but a desultory way: and no one is to blame. 'Tis but a recreation, and like all others is cast aside when it begins to cloy. It is a pleasure to chronicle that this is not the invariable ending of such enterprises. Many of these wealthy mechanics have an earnest and sincere liking for this rugged calling and energetically devote themselves to its advancement, and such are to be heartily congratulated. No calling is more honorable, and no pleasure more keen, than that resulting from the accomplishment of some intricate or difficult mechanical operation, and it is sure to expand the mind in many directions. Many people are intuitively mechanics. Everything is skillfully done. While others must study a machine or process to master its details, it seems the lot of these fortunate ones to simply read them, so plain are these problems, that they scarce require a passing thought—the mastery of them lies in their simplicity. These are the fortunate ones that have within themselves the making of the most skillful mechanics—and many do. But many do not make any advance beyond their brilliant beginning, perhaps believing that as fortune favored them so far without study, she will still carry them through. There is opposed to these, a class who have a great liking for the mechanical arts but whom Dame Nature, with inscrutible wisdom, has provided with less shining talents—study and practice being necessary for the accomplishment of any material success or progress. These are the ones who appreciate instruction, nor falter or turn aside when faced with a task that requires study, and these, too, are the ones that ultimately make up the nine-tenths of the really first class mechanics. The other tenth, of course, comes from the ranks of the first mentioned. Failure is sometimes worth more than success—it spurs to more vigorous effort, and the despondent amateur or apprentice, to the kindly advice of Longfellow, may "still take heart." Perhaps something to follow may help him.

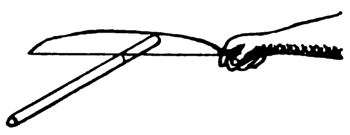


Fig 1.

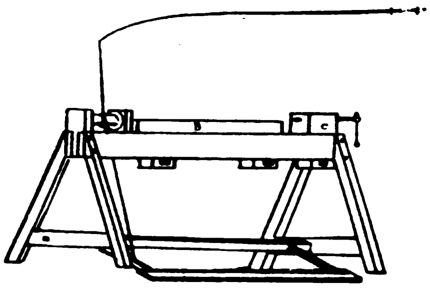


Fig 2

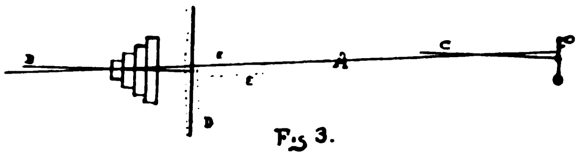


Fig 3.

In choosing a work shop room, the first and most necessary requisite is good light. If windows cannot be on all sides or on opposite sides, at least have them on the south and west sides. They will give more light and light longer. That portion of the bench to which the vise is affixed should be in good light or the difficulty of doing fine or close work will be greatly enhanced but care should be taken that the direct sunlight does not fall upon the work, or upon the worker's eyes. It is not only very tiresome but also injurious. The bench with its vise must be had. They are of no good except to look at without various other hand tools, hammers, files, cold chisels, punches, wrenches, and many others are desirable and are supposed to be in possession. But *the* one tool, pre-eminent and before others is the lathe—foot lathe. There are thousands of operations to the perfection of which it is very essential—turning, boring, drilling, polishing metal, spinning, grinding, spacing, graduating and a host of others, equally within its range.

The lathe from its inception to its present perfection has passed through many changes. To its inventor and the countless multitudes who have assisted in bringing it up to its present state of perfection, a world of gratitude, and thanks are due. But to whom to give the honor of the invention is not known. Even the century which saw its birth is not certain—the year lost in the mist of ages. Even the origin of the name—Lathe—is uncertain. Many writers adduce many ingenious and original fancies and logical deductions, all tending to or giving the origin or derivation of the term, but they all fail in two important particulars: plausibility and certainty. This much is very generally conceded. The bow-lathe was undoubtedly its first practical form. In this the work was placed between two fixed centers The bow was long, flexible, and curved, with the bow-string or strap fastened at the smaller end. The mode of operation was to place the strap around the work, near the end, draw it taut, and grasp the loose end of both bow and string with the one hand. Fig. 1. gives an idea of its application. It is evident that a longitudinal motion of the bow will cause the work to revolve. When the end of the bow is reached the motion of the bow is reversed. It will be evident that this revolves the work backward, and for this reason the chisel is applied to the work only in its forward motion.

It will be observed that the strap should be placed around the work from over the top, which gives the motive force, to the end within the hand, the bow simply serving to take up the slack and to carry back for the next operation. This old device, though never used in America to any great extent, has served an apprenticeship abroad. It is not difficult to find in many Southern Asiatic cities, dignified Orientals with flowing robes and snowy beards, gravely seated upon the ground with the bow-lathe before them, deftly turning out the beautiful articles of bone, ivory, horn or wood, wielding the bow with one hand, holding the chisel with the other, while with marvelous ease and certainty he guides it with his toe.

The legitimate successor of the bow-lathe was the spring pole and treaddle lathe. It not only made it possible to do much larger and heavier work, but made both hands free to manipulate the chisel, thus affording more rapidity and certainty. Later a spindle was added with a spur center, the strap removed to a winding drum on the spindle—dispensing with the adjustment around each piece of work—till now necessary. Fig. 2 shows its general plan. This is the design of a lathe used by the writer's great grandfather, who settled in the early days of the State, near Marrieta, O. Many specimens of his work are still in existence, and shows that indifferent tools were no bar to good work. Time and progressive ideas advancing, deemed the time lost in running backward at every stroke, and sought a remedy. The balance wheel pitman and treadle was added with a great gain.

But as before intimated, lathes of very ordinary capacity and clumsy design were difficult to secure, and in strong contrast with the spirit manifested by the builders in those times, are the generously progressive builders of to-day—generous from the rivalry of competitors, progressive in accordance with the demands of buyers—between whom prosperity is reciprocal, for a customer secured and delighted, buys from no other and makes a success of his venture, while a maker who deceives and humbugs his patron loses his future custom as well as his friends. It is very gratifying to know that lathes of such excellent designs and workmanship are to be had at such reasonable prices. Never were the times more in harmony with the wishes of the apprentice or the amateur. It is the design of each to get along with his calling—" nothing succeeds like success" and the grand principle that underlies that accomplishment is in propitiating the Goddess of Fortune with worthy offerings—good tools. But the uninitiated is destitute of a knowledge of what goes to make up a good lathe. The first thing to consider is its weight—a heavy and substantial machine that will endure the strain resultant from work to its full capacity. It is desirable that the band wheel be of such weight that its momentum will push the spindle without falter through the varying inequalities of the work, the spindle large, the bearings long and well fitted all around—not merely the top and bottom, with means provided for adjusting when worn. While it is necessary that there should be no lost motion in the spindle, it is equally essential that a foot-lathe should be light running. Demand that the carriage have a good bearing upon the ways, the length, at least, equal to the full swing of the lathe, and that its movements be easy and free. While the gearing of the pinion and the rack be sufficiently close to do away with the most of the back lash, they should not be so close as to bottom at every tooth. If the cross slide does not swivel it should be at right angles with the ways of the lathe. Both spindles, live (head stock) and dead (tail cock), should be exactly parallel with the ways. If the live spindle is not it is impossible to bore work straight or to turn up face plate work flat.

Its truth may be tested by taking a cut over the face plate and trying the plate with a straight edge. If it is concave, that end of the spindle is nearest you, if convex, from you. If the face plate is straight across, the spindle is in line with the ways. It is equally essential that the movement of the tail stock spindle should be straight with the ways. If it be out of true there is but one point of extension at which it will turn straight. If the spindle be extended beyond the point where the centers coincide, one end of the work will be larger than the other. If not extended so far the other will be the larger end—the difference in size will be twice as much as the centers are out of line. Another troublesome effect that an "off" tail spindle produces, is experienced in attempting to drill a hole in chuck or face plate work by feeding the drill in by the tail stock. A twist drill will start readily, but if any considerable depth is to be bored, the angular travel of the tail spindle soon makes the drill bind, and increases with the depth. Study Fig. 3. A is a line centrally located between the ways, B the live spindle, C the tail spindle, D, dotted line, the travel of the tool on the carriage, at right angles with the ways of the lathe. The dotted lines behind the face plate shows the shape work would be faced to on this lathe, and the lines E E, indicate that work chucked to the face plate would be bored much larger as the tool progressed.

Go via the Nickel Plate on July 1st, 2nd and 4th, at one fare for the round trip.

LETTERS FROM M. C. MAC—SHOP WORK—"DOLLY" AND THE WHEEL.

There is one machine that, so far as I know, is common to all general machine shops, viz.; the "big lathe." There is a variety of them, and no two of those I have seen are the same size, make or design. Some were new and in good order, and had the appearance of having been well cared for, but the majority were old and covered with scars that could be attributed to carelessness of the workman rather than any fault of the manufacturer. Others were not only old and badly used, but were a kind that never were any good, one of which I shall speak of later on. One was a gap lathe, a sort of a make-shift for any kind of a job, but not a real good lathe for any kind of work, all of its better qualities being sacrificed that a big lathe might be made of a small one.

I worked in a shop several years ago that had one of the worst and meanest big lathes I ever saw (the one just spoken of above). The only use I had seen it put to was that of a repository (especially the tail end of the bed plate) for miscellaneous shop tools, such as the "old man" and ratchet, belt-clamps, and all the scrap that were too good to throw away, but scarcely worth keeping. Almost anything could be found there from a pair of crippled trestles, to the last new twist-drill.

I had not been working in that shop long, when a large gear wheel came in. It was rolled over by a post near the lathe, and presently the foreman came around where I was working and said, "Mac, it is your turn to run the 'Dolly Varden:' (a name some admirer of Dickens had given to this old scrap pile, 'Uriah Heep' would have been much more appropriate, but it was too familiarly known as 'Dolly Varden' to ever be changed). So bore that wheel out to 8" for Smith & Co." I was surprised when he gave me the job, saying to him that he had better give it to one of the older men in the shop who were acquainted with "Dolly." But he would not listen to any such argument, so thinking I could get sick by morning, I asked him to let me finish the job I was at and tackle the wheel in the morning, a proposition to which he consented. I felt elated over this ruse to beat the foreman, but that evening, thinking the subject over, I concluded that this old, chestnutty scheme should be abolished; therefore instead of "playing off sick" I improved the time in formulating plans for the purpose of making love to "Dolly" in the morning.

I tried hard to remember her general make-up, but failed to recollect anything that I could at that time make use of, except that she had no chuck and that her face plate was very thin, consequently I might have trouble in truing up the wheel sidewise, owing to the springing of the face plate. To obviate this, and as the wheel had six arms, I would clamp it to the face plate in but three places, with my blocks and wedges directly under the clamps. I felt well satisfied that this plan would work O. K., and as I could not remember any more of her peculiarities, I dismissed the subject, after making a resolution that I would not lose my temper, no difference how often "Dolly" might mitten me before I got the wheel bored.

In the morning I gave her a looking over and found her to consist of a head-stock, tail-stock, wooden bed-plate, shod on top with cast iron plates with raised V's that had never been planed and a variety of compound rests that could be set at any angle desired, and then bolted fast to the bed-plate, or "shears," as they are often called. The compound rests with their ratchet and screw feed very closely resemble the cross-head of a planer, and had to serve the same purpose on this lathe, as the carriage does on the engine lathe of to-day. The rests were badly worn in the most used places, were springy—no adequate means having ever been provided to hold them rigid.

One of the first things that I do when I have a job on a machine that I am not accustomed to working on, is to see if there are suitable tools. I did so in this case and found all the tools for the "Dolly" in good shape—for the blacksmith. They were all big and clumsy, hard to grind and heavy to carry around, so to avoid all this, I had the smith punch a ⅞" square hole in the end of the longest tool and made a boring bar of it, by drilling and tapping a hole for a set screw to come down on top of a tool in the ⅞" square hole punched by the smith.

I want to say a few words in favor of boring bars of this kind. In the first place they are cheap, one bar and a lot of small tools, taking the place of a cart load of big ones. The small tools for the bar are easily dressed and ground, nor is there any more waste steel, for the small tools may be used up very close. Tools ⅞" square can easily be used when only 1½" long. Of course the kind of work to be bored will determine the length of tool when new. I do not know how small work would have to be in order that a boring bar as described could not be profitably used. I know of one instance where they are used on 20" lathes. The one I saw was made of 1¾"x¾" tool steel with a square hole in the end for ⅝" square tool. Among the other tools used in this bar was an 8-thread chaser that could be used for threading pipe fitting any size pipe larger than 2." I was told that a pipe flange could be threaded in less than half the time with this bar and chaser that would be required to do the same with the single point thread tool. Neither does it cost as much to make the chaser as it does to dress and file up the single point tools necessary to do as much work as the chaser. The expense of the "hot" or "master top" for cutting the chaser, is not included, but as they may also be used for other shop purposes, they ought not to be charged wholly to the chasers.

If the reader will pardon the digression, we will return to "Dolly" and the wheel. I thought it would be a good idea if I could get the rest set so it would bore a straight hole, before I put the wheel on. Thinking the foreman could assist me in this respect I called on him for information. He replied that there used to be some marks that would serve as a guide in setting the rests, but Gus, the Dutch boy, who was helping me, said that the man who run "Dolly" before told him that "dem marks vas not so near as a mile, vere dem bin ven she bore sthrait."

Accepting this information from Gus as being worthy of investigation, I put a newly turned piston rod in the centers, and then set the rest parallel with the rod, after I had slued the tail stock around to bring the rod square with the face plate. I was just as accurate in squaring the bar with the face plate, and then setting the rest with the bar, as my skill permitted, intending to bore the wheel straight without having to alter the rest to make the hole as near straight as they are usually bored. The wheel was then rolled up onto the bed and wedged up till it was as near the center of the face plate as I could measure, then blocked out from the face plate the same distance all the way around, then clamped, as was planned the night before. The wedges supporting it were then knocked out, and the wheel was found to require but little adjusting to true it up.

By this time the smith had the bar and tool made. I got Gus to drill and tap a hole in the bar to fit a set-screw that I had happened to find. When this was done a cut was soon started. Then Gus looked up with a disappointed expression on his countenance, and asked: "Vy you don't some times stand und cuss for a haf hour efery fifteen minit dot lathe, like all the oder new mans ven he run 'Dolly Warden?'" Thinking to have some fun myself I got him to tell me all he could remember that others had said about "Dolly," some of which (though not publishable), delivered in his broken way, was as laughable as anything I ever listened to.

About this time the thread gave out in the neck in the rest, and in consequence the feed has stopped. She had just slipped her hand out of the mitten, as it were, and grabbed the lines and stopped the rig before a fellow had time to recover his senses.

It was then that Gus's countenance grew radiant with the expectation of the explosion of a lot of stock expressions that the average machinist carries for such occasions. I have no doubt but that I could have done ample justice to "Dolly's" behavior on this occasion, had I let myself out, but I did not. I just simply exchanged the ratchet from the screw on the rest to that in the the tailstock, and lengthened the universal arrangement for operating the ratchet, and then pushed the tool through with the tail centre, by interposing a distance piece between the centre and end of boring bar. I got the wheel bored and key-seated without any further trouble and afterward made a new nut for the screw in the rest.

Everything went smoothly in the shop for a month or so, when another job came in for "Dolly." The foreman, after giving me some "taffy," gave me the job, to which I objected, as it was not my turn to run her. Then he gave me more "taffy." I thought a moment, and, considering that I had the mitten, I would give it back to her for all it was worth, so I said to the foreman that if he would give me 50c. a day extra I would run "Dolly" and under no condition except as my turn came round. This demand proved to be the rock on which we split, for I was soon working in another shop.

Continuing with the class of lathes used as an initial for this letter, will say that there is generally plenty of evidence to be found around the shop somewhere to prove that at least once in its life the big lathe was not big enough. The evidence consists in the more or less substantial means for the head stock to rest on when elevated to swing some job that the manufacturer of the lathe never intended it for. I do not think there was ever a shop built, but, about the first thing came to be done was too big to get in the door. This does not imply that the job can't be done at the shop, for there is usually room outside. The resources of the management often compensate for the smallness of the shop or tools. It is not difficult for a machinist to say, "that job is too big for my machine to handle, and I can't do it." I do not say this to ridicule men of this kind; far from it, but every general machine shop should have a few men who believe they can do anything that comes along.

These are the kind of men who exemplify the fact that we do not know what we can do till we try. I asked a latheman of this kind, the other day, if he could turn a piston rod with the piston on it, that was too big for his lathe to swing, without raising the head and tail-stock so the piston-head would swing. He replied promptly that he could, and I as promptly asked how he would do it. He replied as follows:

"If the piston lacks but little of swinging, the bed may be chipped out to clear it, as most of the large lathes are. But suppose it lacked 2" or more, I would run both ends of the rod in steady rests, blocked up high enough to let the piston swing. I would put collars with set-screws on either side of the jaws in one of the steady's to prevent end play. For a driver I would bolt an angle plate on the face plate of lathe, and have the piston close enough for the angle plate to strike one of the hubs, or any projection on the head, provision being made for sliding on the angle plate, equal to twice the distance from the center of the piston, to that of the lathe. Then I would adjust the piston in the steady's till it is parallel with the lathe bed, by running a tool along it, then get a tool elevated till it is the right height for the rod, and go ahead, just the same as if the work was on centers, except I should be more careful."

This scheme looks so practical that I think I should adopt it if ever occasion require, in preference to raising the lathe heads. The motion would be irregular, in fact just about the same as that of a quick return crank shaper.

M. C. MAC.

·Niagara Falls Excursion.

The G. A. R. Band, of Cleveland, have arranged to run an excursion to Niagara Falls, via the Nickel Plate, on Saturday, July 2d. Special train will arrive at the Falls early morning July 3d, and will reach Cleveland returning morning of 4th. Tickets good until July 7th, only $3.00 for the round trip.

Cool Shade,

Can be found at Vermillion, O., and those who wish to attend the Camp Meeting at that place during July and August can procure excursion tickets via the Nickel Plate from June 21st to August 23rd at special rates.

4th of July Excursions.

The Nickel Plate offers its patrons one fare for the round trip. Tickets good going on the 1st, 2nd and 4th, returning until July 6th.

Niagara Falls, $3.00; Toronto, $4.00

G. A. R. Band Excursion via Nickel Plate, Saturday night, July 2d.

GROWTH OF MECHANICAL ENGINEERING DEPARTMENT AT THE UNIVERSITY OF PENNSYLVANIA.

About three years ago the University of Pennsylvania, at Philadelphia, gave a new impetus to its mechanical engineering department. Each year thereafter it outgrew its quarters, until, in '91, it was decided to erect two buildings for this department, one to be partially occupied by a light and power station, which should also afford students the very best means of studying practical work.

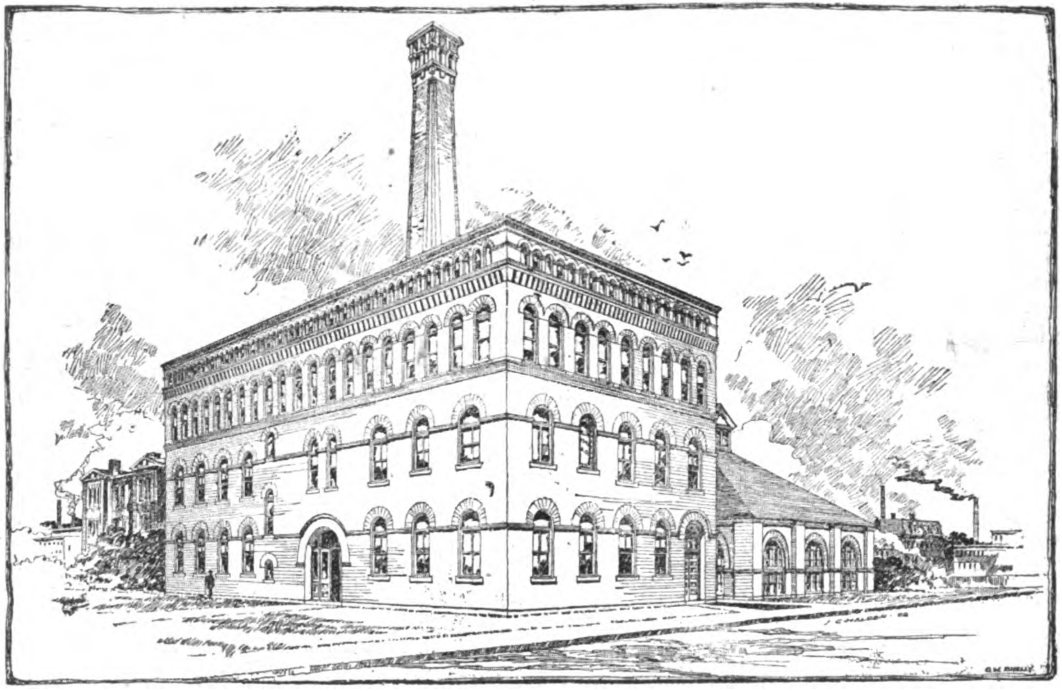
The illustration shows one of the buildings, the quarters of the engineering school proper.

When completed this plant can not be equaled by any in this country for the teaching facilities it will enable this Department to use, as it will be not only a plant installed by competent engineers to do economically commercial work, but with especial care as to its usefulness as an aid to the instruction in mechanical engineering.

This building is to be practically four stories high and 100 by 50 feet on the ground. On a portion of the ground floor will be placed the engines and dynamos for lighting the buildings of the University. This plant, like the boiler plant, has been planned not only to be commercially a successful plant, but to give the largest amount of opportunities for the students to study the peculiarities and test the efficiences of the best types of engines and dynamos. This plant will be of 300 horse-power, and it is intended to install four engines driving six dynamos of various types. The balance of this floor, about 2,000 square feet, will be devoted to the purposes of the mechanical engineering department proper.

On the second floor will be the remainder of the mechanical laboratory—a second room 40x50 feet, in which will be installed much of the apparatus now in the laboratory in the College Hall. On this floor also will be the office of the department, three class and lecture rooms and the closets.

On the floor above will be located the drawing room—a room covering 2,000 feet of floor space—the electrical laboratory and photometric room, covering 1,600 feet of floor space, one class room and the assistant's room. On the fourth floor will be located the model room, in which will be placed the models of machinery of various kinds, kinematical models and a series of very fine plaster models cast by the students for patterns of their own make, showing the methods of using cores and making castings.


THE NEW MECHANICAL ENGINEERING DEPARTMENT OF THE UNIVERSITY OF PENNSYLVANIA.

This department has charge of both the mechanical and the electrical engineering work done by the University of Pennsylvania. There are practically two courses of instruction open students in this work. One of these courses has been established for a number of years, and is only open to students who have taken the first two years in the Towne Scientific School, or who come prepared to pass examinations on the work of these two years. This course extends over three years. The department has graduated from this course upwards of one hundred students, most of whom are actively engaged in some branch of engineering work.

The other course extends over four years and admits students after examination on the subjects usually required for admission to college. The studies taken in this course bear directly on the work of the engineer. At the end of the second year, the studies are differentiated somewhat for those students who desire to pay particular attention to electrical engineering, although all students, taking either of the courses, are given a good working knowledge of both mechanical and electrical engineering.

ABOUT CRUCIBLES.

F. P. Yattaw writes in answer to "Brass Molders" as follows: In my opinion a crucible should be kept on top of the furnace or where it would be subjected to considerable heat for several days before using, and should, finally, be brought to a cherry red, mouth down, in the furnace. I have taken 34 heats in a 120-pound crucible treated in this way, seventeen of those heats being phosphor-bronze and the remainder Ajax metal; both being severe tests on a crucible's staying qualities. They should never be set where a draft of cold air can strike them while cooling off.

In answer to "Brass Molder" I would state that all clay crucibles, new or old, should be gradually heated, with the mouth downwards, up to a red heat before charging; and whether in the preparatory heating or in the subsequent firing for melting purposes, the crucible should be covered with the fuel, otherwise, the unequal temperature, induced by carelessness in this particular, will result in a "broken pot." If clay crucibles could be kept constantly in use without allowing them to become cold, and supposing them to be made of the best possible material, there is no reason why they should not last from 15 to 20 meltings, especially if they are kept clean from scoria and patched now and again with fine silica sand, ground coke and fire-clay. Too much care cannot be exercised in the kind of lifting tongs used; if they do not fit the pot snugly the result is that a split occurs on account of the unequal pressure against the sides when the weight comes on; especially is this the case with large crucibles. If continuous melting is not in order, the next best thing for saving clay crucibles is to keep them as hot as practicable during the time they are not in use, and in all cases let them be returned to the furnace mouth down when the heat is over, so that the cooling may be effected as gradually as possible. If new clay crucibles, of the best quality, are stored in a place absolutely dry, and the above directions for use strictly adhered to and carried out, there is no doubt of their ability to stand as long as herein above stated. The best graphite crucibles should last from 20 to 35 meltings; and, while they are less liable to fracture from sudden changes in temperature, it is well to observe, in some measure at least, the instruction given for clay ones, if best results are looked for. These remarks apply to crucibles when used for brass only.—[S. Bolland, in Machinery Molders' Journal.

THE BEST MODE OF CLEANING CASTINGS.

In fitting castings, the first thing is to get the sand off of them as soon as possible. Nothing has yet been found better than the tumbling barrel for small work, but for large pieces, the slovenly vitrol vat is adhered to in most of the shops. There is a better and quicker way of cleaning castings than to pickle them a day or two in very dilute sulphuric acid, and that way is with the sand blast.

Sand becomes attached to a casting by being partially melted during the process of casting, and while in the melted, or semi-fluid state, it is welded to the iron with which it comes in contact when hot. Then, in order to remove the "melted on" sand, the particles must either be pounded until they become loosened and fall away, or they must be removed by dissolving away the surface of the iron, using an acid for that purpose, a mixture of one part of sulphuric acid (oil of vitriol) and ten or twelve parts of water, being the mixture generally in use.

The sand blast will clean the sand from a spot on a piece of iron where the blast impringes, in a very few minutes. The sand blast is formed by forcing fine sharp sand with great velocity against the surface to be acted upon. Compressed air may be employed for driving the air, but in some cases it may be more economical to use the steam direct for driving the sand, while in still other cases it may cost less to use the steam for driving a steam engine, and then compress air by mechanical means to blow the sand-blast.

The instrument necessary for the application of the sand is nothing more or less than a sort of injector. It possesses a nozzle from which the stream of sand and air or steam is delivered; and back of nozzle is a tube leading back out of the injector at a sharp angle. Through this tube the sand enters, flowing in partly by its own weight, and assisted a good deal by the partial vacuum formed in the sand tube by the action of the steam jet while passing the end of the sand pipe. The action of the sand blast is peculiar. The harder the substance against which it strikes, the greater cutting power it possesses. This may be well illustrated by holding the hand in a sand blast. The flesh is uninjured, while the nails being harder, are attacked by the sand, and would be badly injured, in a short time. If a piece of glass be held in the hand, the glass is deeply cut into, while the part protected by the hand is not affected in the least. The piece of paper gummed to the glass, or metal which is being cut, will afford complete protection, and will not be touched by the sand blast, while the harder substance is quickly cut away.

A practical apparatus for cleaning castings by sand blast would consist of a tank or hopper containing sand, and for convenience located in the roof, or upper part of the foundry, at any chance, in some place where it would be out of the way. The sand would be led down by a rubber hose, and the steam supply connected to the combining instrument by a flexible tube of rubber enclosed in an armor of steel in the form of a long spiral spring.

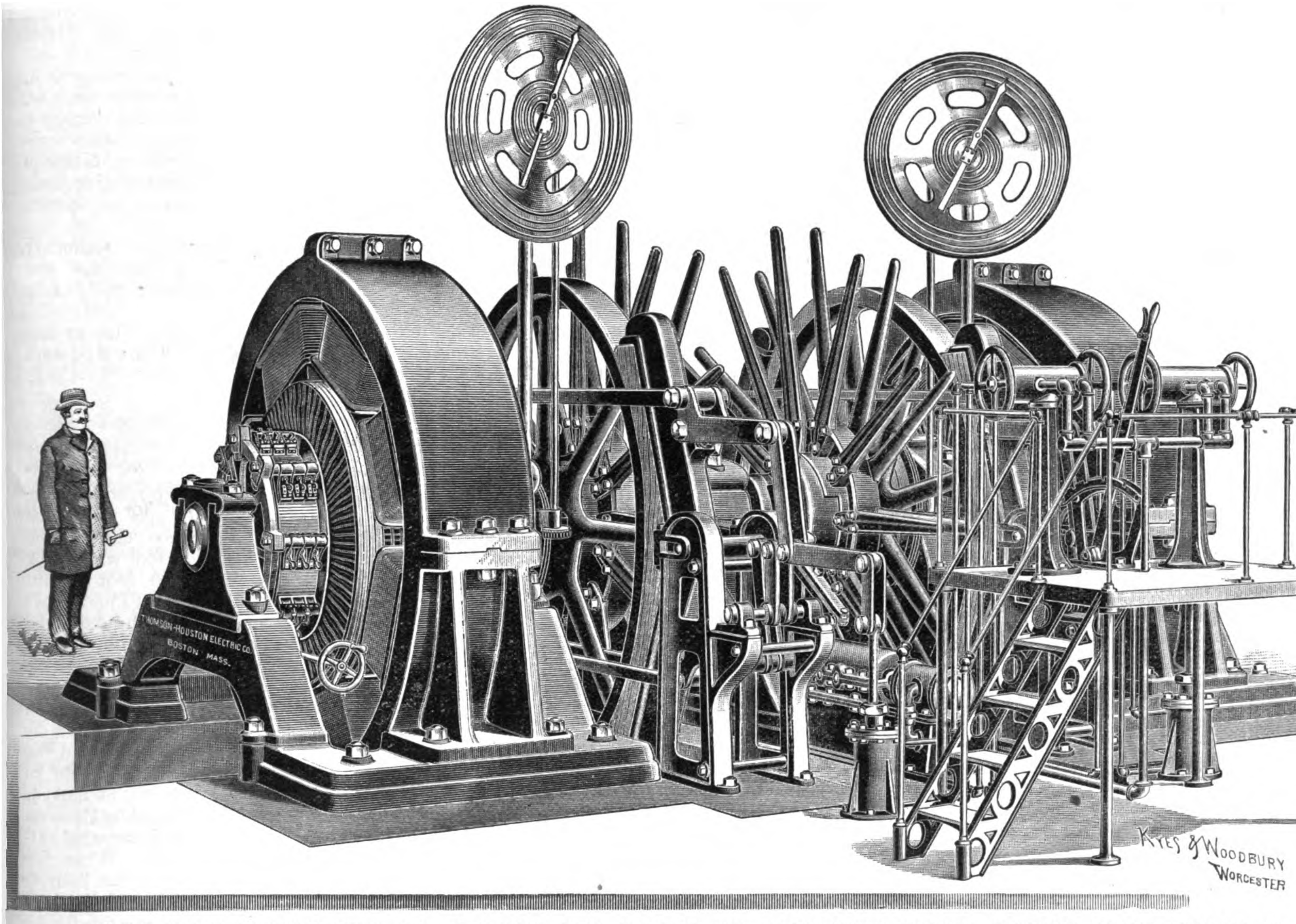
The casting could be laid on a bench, if small, or suspended from a crane, if large, and the sand blast quickly and easily applied to the entire surface. Then the workmen will be able to regulate the distance of the nozzle from the work, so that places where sand is thick may be treated vigorously by holding the nozzle at a distance from the work, thus allowing the sand to spread over a large surface.—[The Tradesman.

FOR the first time since the Amalgamated Association was organized the iron manufacturers at Pittsburgh on June 17 addressed its delegates in their convention advising them to accept a sweeping cut in wages for every iron worker represented.

DIRECT-ACTING ELECTRIC HOIST FOR FLAT WIRE ROPE.

The rapid hoisting of heavy loads from deep mines by the direct application of the power to the reel shaft without the intervention of gearing, offers the most favorable conditions for the use of the electric motor in hoisting work. Much greater economy can be shown in the use of power while a high hoisting speed can be safely and easily attained, a matter of importance where large quantities of ore are to be handled. Gearing has its limits, both in speed and safety.

Herewith is illustrated a direct-acting electric hoist using flat wire rope, operated by two "P. M." type motors, one on each end of the reel shaft, each capable of developing 500 horse-power, or having a combined output of 1,000 horse-power. This hoist is built by the Thomson Van Depoele Electric Mining Co., Boston, and is designed to raise a load of 10,000 pounds from a depth of 2,500 feet in one minute. Of course, for hoisting and lowering men, or for other purposes, any desired speed can be obtained at the will of the operator. Lowering can be done under complete control of the motors and without the use of the brakes, if desired. Post brakes of a very powerful and effective type are used, being drawn together by rods above and below the reel shaft so that all parts move in parallel lines, distributing the wear equally on the brake shoes and applying the pressure at two points in each shoe equally distant from the center. The shoes are also pivoted at the center so as to quickly adjust themselves to the faces of the brake wheels. The clutches are of the jaw type, that portion of the shaft upon which they slide being hexagonal in form. Both clutches and brakes are operated by cylinders using compressed air. A small air compressor driven by an electric motor is placed at the center of the hoist, supplying air for this purpose. The compressor requires no attention whatever, being automatic in its action, stopping when the pressure in the receiver forming its base reaches a certain point, and operates entirely independent of the hoist. Two sets of valves, actuated by hand wheels, one for brake and one for clutch, are placed convenient to the operator on each side of the center of the hoist, each set controlling the brake and clutch on its side. A powerful, reliable and positive means of operating both clutches and brakes is thus provided, requiring practically no exertion on the part of the engineer.


THOMSON-HOUSTON ELECTRIC CO.
BOSTON, MASS.
KYES & WOODBURY
WORCESTER

DIRECT ACTING ELECTRIC HOIST FOR FLAT WIRE ROPE MADE BY THE THOMSON-VAN DEPOELE ELECTRIC MINING COMPANY, BOSTON.

The brake wheels, reels, etc., are, as will be seen, of the usual form, the brake wheel being keyed to the hub of the reel, which runs loose upon the shaft when not in clutch. The reel hubs are bushed with hard composition, means for their thorough lubrication and easy removal being provided.

Dial indicators, operated by worm gears on reel hubs, are attached to each reel, showing the position of the cage in the mine shaft. All levers are arranged within easy reach of the operator, so that one man can attend to both reels and brakes without difficulty. Particular attention has been given to the motors, so that all adjustments can be quickly and easily made and access had to all parts. They are mounted on heavy bed plates, also used for the two bearings at each end of the reel shaft. A rheostat of ample capacity is provided for obtaining the slower speeds, resistance being thrown in or cut out by means of a controller and lever for operating. A reversing switch and lever for lowering is also provided.

The extreme compactness and simplicity of this machine, as compared with direct-acting hoisting engines fitted with their complicated cut-off valve gear, will at once be noted. Only about one-half the space is occupied, as by steam hoists of the same capacity, insuring a great saving in buildings and foundations alone, while the well known economy of the electric motor in the use of power makes its application to direct-acting hoists requiring large power of the utmost importance in a commercial sense.

SCIENTIFIC NOTES.

Successful tests have lately been made with a new attachment for carding engines, an arrangement designed for the stopping of the machine. The shaft in the upper calender roller is in this instance prolonged a little beyond its bearings, and at its end is affixed a worm gear into a worm wheel, which is mounted on a stud attached to a bracket on the frame. The wheel has a pin affixed to its surface, which engages with a lever acting upon one end of another lever, the other end of this latter lever being bent so as to pass under a catch on one side of the doffer lever, which lever is supported in working position by the catch. The effect of this mechanism is that if the sliver is passed through calendar rolls at a proper thickness the worm on the upper calendar shaft is held out of contact with the worm wheel. If the sliver is too thin or is entirely absent, the worm folds into a gear and rotates the worm wheel, and thus removes the levers about their centers, releases the catch attached to the doffer lever, and stops the engines.

Some interesting experiments are described as having recently been made in Boston involving especially the remarkable processes of the forging and tempering by electricity of obdurate metals. Among the most notable of these was the operation of melting into liquid form a bar of steel an inch in diameter and 12" long in the brief space of 45 seconds without the temperature of the room being raised a single degree from its normal condition. Another operation described is that of making a steel railroad spike, in this case a bar being cut into the required length, and the pieces passed through an electrical machine, where one end is heated, and then by means of a die a head is shaped on the heated end, the point being compressed into the shape desired without being subjected to heating. Another and not less practical mechanical application of this power was the forming of an auger screw, a flat bar of iron being fastened in the machine at two ends and heated almost instantly, and afterward twisted into the spiral.

MANISTEE, MICH., although not a very large town, may justly claim to have a model arc-light station, the unique feature of it being a tall tower which is used as an observatory and signal station. The peculiar topography of the town enables the superintendent of the lighting plant to observe from the signal tower whether the lighting circuits are operating properly, since almost any street lamp can be readily identified from this elevation. Besides, it is possible to communicate with the employes in different parts of the town by flashing signals from an arc lamp on the summit of the tower.

A SET OF FINE TOOLS.

BY WM. HARRISON.

[Let not the reader whose taste does not run to that which diverts as well as instructs the minds, and who shuns fiction as unprofitable stuff, think that he will violate his custom by perusing Mr. Harrison's paper. It is essentially true, and those who skip it will miss a narrative that substantiates the saying that "Truth is stranger than fiction."—ED.]

RECAPITULATION.

Charles C. Adams, a mechanical engineer and instructor in a technical school, is reduced by sickness and his bad financial management, to distress. While in these straitened circumstances, a gentlemen, calling himself John W. Ellis, visited him and gave him employment. The work was to make from certain drawings a set of tools, which, Mr. Ellis explained, were to be used in constructing the model of a very important invention. There was to be absolute secrecy. Five hundred dollars were paid down, and as much more when the work was finished. The job took about a week. Ellis set the price himself, and the reasons he gave for paying so much satisfied the maker.

Mr. Adams now had not only sufficient funds to relieve the distress of himself and parents, but was able to develop an invention of his own. He was a most prolific inventor, but only this one patent was commercially valuable. He went ahead with it and in a short time became wealthy. The strain of providing a competence for himself and parents being now eased, he devoted his attention to a young lady, Miss Ludlow, whose hand he asked in marriage. The lady herself was quite willing, but the father was in no haste to accord his consent. On the occasion of the interview between Mr. Adams and Mr. Ludlow, on the subject, which it was expected would be final, the latter produced a pair of long forceps, which had been left behind by a burglar who raided a neighbor's house, and showed the astonished young inventor and manufacturer the name of "C. C. Adams, Detroit, Mich," stamped in the steel. There was no doubt that the instrument was one of the set made for the alleged purpose of constructing a model, nor that Mr. Adams had, instead of handing the blacksmith the stamps furnished him for this purpose by Mr. Ellis, substituted his own for them unwittingly, with the result that his name was on every piece of a large kit of unusually fine and dangerous burglars' tools. He is in an uncomfortable position and can not make Mr. Ludlow believe in his innocence. When suffering the worst from the unfortunate dilemma, he is suddenly introduced to Mr. Ellis, at a party at the Brunswicks, as S. V. Ashton. He has an interview with Mr. Ashton and one Mr Bellknap, and is quite well satisfied that the former is straight, notwithstanding the evidence against him. With an ingenious excuse, he gets a promise from Ashton to bring the tools to his office, and goes home much relieved. But when the time comes for delivering them he receives a letter that every one has been stolen.

It was Thursday evening, and the principal street of the beautiful metropolis of the Wolverine State was lined with people out on dress parade and for recreation. There were the fairly well-to-do middle class of business people, artisans and clerks, while the extremes—the poor and the rich—were properly represented, from the shabby-genteel who endeavored to hide their rags by artificial methods, the plain, unpretentious poor, and the swarthy sons of Italy and of Poland just landed, to the proud and disdainful plutocrats with their shining liveries, and that class, too numerous in this country, who toil not, neither possess any tangible property, but are always dapper, well supplied with funds and floating in the society of the opulent.

To the latter classification belonged two young men who came jauntily down the street, watching the carriages attentively, and saluting, with Chesterfieldian politeness, every one who gave them the least chance. When they reached that part of the city where the better retail establishments end and the wholesale and nondescript business places commence, they turned off on a side street and walked rapidly in the direction of the depot. Entering a building which had once furnished quarters for an immense jobbing house, but which had, in the shifting of business centers common to all rapidly developing cities, become the habitation of a miscellaneous class of tenants, they ascended the stairs to the fourth floor and entered, from a dark and battered hall, a back door with no number or sign thereon. They passed through a small room into one of goodly size, which had the appearance of being a kind of store room. There were boxes and packages of paper on shelves, and in one corner was a closed cabinet. On a common kitchen table sat a dirty lamp, which was at once lighted.

"Fill up," said the taller individual, as he tossed a bag of tobacco to his companion, "we might as well take a whiff while we give the scheme the finishing broil." They filled their corn cob pipes and sat down.

"I must not fail to get that kit of tools, or as many of them as are left, over to Adams," said one of them, who will be recognized as John W. Ellis, alias Sylvanus V. Ashton.

"I wonder what he wants them for," replied Mr. Bellknap, fixing his black eyes on his companion. "Wouldn't his suspicion be aroused if he should show them to some one else? Surely no one but himself could be mistaken in them. They were peculiar, I know, and might not be detected, but I would send but one—and that the most simple one I could find." While he was talking he reached in a drawer, drew forth a small pair of pincers, and laid them on the table. Mr. Ellis picked up the instrument and toyed with it, occasionally examining some part of it indifferently.

"Adams takes every one in good faith," he said. "I am entirely satisfied that he told the exact truth, but I shall take them over, anyhow, and see what he will do. It is fortunate he asked for them, because we could have no good reason to call there and cultivate him as we must to make the engraving scheme work, without some such matter between us."

He stopped whirling the little instrument on his finger, and, holding it close to the light, scrutinized a certain spot sharply. Then he laid it down and went to a drawer in the cabinet and took something out. Holding it to the lamp he examined it carefully. There was at first a puzzled expression on his face, which quickly gave way to one exceedingly felicitous. He stepped up behind Mr. Bellknap and delivered a slap on the back which sent him sprawling on the table.

An angry oath escaped the lips of the prostrate man, as he sprang to his feet and made a lunge at Mr. Ellis. They clinched, and there was a lively scuffle for a few moments, when Mr. Ellis called upon his antagonist to desist, promising to explain the cause of the assault. They sat down and Mr. Ellis placed the pincers before Mr. Bellknap and said, "Read that."

"Great ——!" exclaimed he of the black, beady eyes. "How could that have happened?"

"He got the stamps mixed, and put his name on them instead of the fictitious one I gave him the stencils for. He has found it out and now wants to get them back. Not quite so easy, my boy, not quite so easy! Lets see how bad you want them. Wouldn't be surprised, Harry, if this was the biggest streak of luck we've struck yet."

"But how will he know that they are likely to prove mischievous without suspecting their true use? I can't see the point."

"I couldn't at first, but after putting two and two together it came very clear. Michigan Jimmy lost a pair of the forceps belonging with the kit in Slocum's big house on Lafayette avenue, some time ago. Slocum saw the name, 'C. C. Adams, M. E., Detroit, Mich.,' on it, and knowing there was no other such a person in town but the inventor and professor who was courting Miss Ludlow, he went to the girl's father with it. That's how Charlie found out what kind of a trade the tools were made to work at."

"I se-e-e," said the beady-eyed man, winking and drawing out his words in such a way as to express how deeply he penetrated it, and how much more there was to see in it than could be appreciated in a moment.

"On the strength of this discovery, I think," said Mr. Ellis, "that we can cause our lionized friend to exchange for experience his money and—his intended. You, Harry, may have the money, or a good share of it, while I will take the *intended*. I fancy she cares none too much for him, and by getting the young man and his cash separated, and in the meantime cultivating Ludlow, I see no reason why it may not be your humble servant that will help Si Ludlow's daughter spend her father's money, instead of Charley Adams. The first step is to write a letter to Adams and give some reason why the promise to send him part of the tools cannot be carried out. Then, for the plot."

John W. Ellis, alias Sylvanus V. Ashton, took out some stationary and wrote a note very liesurely. Then, putting it in an envelope and stamping it, he, accompanied by his companion, descended the rickety stairs and deposited it in the first letter box.

"Now, Harry," said the individual of the dual names, "let us lose not a moment's time in getting over the river to Windsor. There'll be work—sharp, nervy work—for the next few days."

(To be continued.)

MACHINE SHOP NOTES.

The rule that the top of the jaws of a vise should be placed just the height of the elbow is wrong. No filer with a practice that gets economical results can file with his body erect and his arm approximately pendant from the shoulder. On the contrary, he should place his right foot well aback to brace himself, face partly to the right, and keep his left foot forward under his weight. The file handle at the start should be about four inches below the shoulder, about six inches nearer the vise than the shoulder, and near the breast. The right thumb should lie straight forward on the file handle, the end of this handle should press back into the hollow of the palm and the fingers should grasp it from the under side. The palm at the joint of the left thumb should lie upon the point of the file and the tips of the first and second fingers should grasp it from beneath, while the thumb extends idly beyond. The elbows should be kept near the body and the file near its point be laid on the work. Then the whole body should be swung forward and a heavy pressure placed on the file before it is moved. Next, with the body as rigid as possible the file is forced forward by the arms alone, for the effective filer strikes out from the shoulder, and the whole attention is directed to keeping it from taking a rocking motion. When the whole length of the file has been in operation over the piece, the body is quickly taken back to the original position and then the file is recovered by a quick action of both arms. A fourteen-inch file is long enough for all day and all week work. I have seen Germans, however, use a longer file and take a step forward in cutting with it, but am satisfied that less work is thus done at a greater expenditure of strength. The vise should be just high enough to place the file level on the work naturally. I like to file a piece about five incher higher than my elbow.

* * *

Prof. Tyndall has demonstrated that it is natural attraction, presumably akin to the capillary attraction, that holds two parallel surface plates together when they are rubbed in contact and that it is not atmospheric pressure as was supposed. In my experience I have noticed that a hard steel plug guage will with no great pressure sometimes weld itself at one spot within a ring gage it tightly fits and so perfectly that it cannot be removed without destroying it as a gage. This often occurs with softer metals, and there are facts which indicate that two pieces of the same metal unite together if they are perfectly clean, parallel and metallic when they are connected and subjected to pressure.

* * *

Being of an experimental bent of mind I recently made two boxes for a counter-shaft and lined the journals with paper board. The way I did it was thus:—but it is thought that this method can be improved on. The boxes were bored out three-eighths of an inch larger than the shaft and then the paper "trunk-board," three-sixteenths of an inch thick, was cut of a size to be the length of the boxes in one dimension and in the other dimension, when bent to a cylinder, to abut tightly end to end. These linings had been saturated in linseed oil and thoroughly dried. They were not very practical to ream, but at last satisfactory holes were made. In use, under a heavy belt pressure, these boxes seem to me to be excellent; and as far as I am able to judge in the few months they have been in use they have every good quality of Babbitt metals and are free from the viscous drag peculiar to these alloys.

* * *

Nitro-chloric acid will recut files in about thirty seconds, but they will be good for nothing. After many experiments it is believed that a resuscitated file is of a very dubious economy. New files stand behind the reputations of their makers, and they will try to make them well. No one is responsible for a recut file.

* * *

Soft open-hearth machinery-steel "water-polishes" better than wrought iron. Do all machinists know that a sharp, stiff, square-nosed tool, if kept wet at the point with water in which is dissolved enough sal soda to prevent rust, will finish a shaft or stud rounder, smoother, brighter, cheaper and better than can be filed? If they do not, and they don't act as if they did, a trip to the shops in Massachusetts where cotton and woolen machinery is made will convince them very quickly.

* * *

When the new tool maker was given his first job, he collected the forgings and other stock and laid them out on his bench which he had previously covered with heavy brown paper. He then took the drawing and spread that out on the bench, and then he got up a stool and put his heels up on a rung. Then he put his elbows on the bench, his chin on his palms and looked at the layout for nearly two hours. The only signs of life that he made in all that time was to write a few remarks away over in one corner of the bench paper. If Mr. McCash hadn't been so surprised he would have discharged him before he had made a stroke. When, however, that toolmaker began to make that jig it seemed to grow both day and night, but no one saw the man exert himself very much. He stood over a lathe, planer, or at his vise so calm, clean and dignified that no one could venture to ask him a question; but when the tool was done it was just right in all things and it had cost less than even Mr. McCash thought it should.

Mr. McCash gave Jack Swifter a similar job the same time the new man started in and Jack would have got it done about four days sooner, but an accident occurred on the planer which necessitated the entire remaking of the body of the tool, so Jack was a week behind. Method is not all, but it helps.

* * *

If a shop has been running a long while a great many experiments may be demonstrated by judicious selections from the scrap-heaps.

* * *

The spirits of turpentine, as illustrated in the drilling of glass where it absorbs all the heat and thus prevents local expansion and consequently the cracking of the brittle fabric, indicates that its affinity for heat is very great. This is more strikingly illustrated with a few pounds of old-fashioned gunpowder, which may be covered with spirits of turpentine, that liquid set afire and be entirely consumed and the flame will die out without heating the gunpowder to ignition. Perhaps this greed of turpentine for heat might be put to advantage in hardening steel. I would suggest the limited addition of it to the oil quenching bath, and the combining of it with cyanide potassium in a sort of emulsion or soapy liquid. It is so inflammable that it cannot be used pure. This application is entirely speculative.

* * *

There is a popular misapprehension as to the hardness of glass. It is softer than hard steel and much softer than corundum (emery), so don't tell any one to make a tool "glass-hard" for a file scratches a window and a hard flat drill will (with spirits of turpentine) drill glass after a fashion.

* * *

Files that have been used on iron or steel will not cut brass or any of the other copper alloys at all to advantage.

* * *

Of course a large or long sheet metal blank cannot be *plumped* through a die when both punch and die are flat and parallel-faced without straining everything and taking unnecessary power. If, however, the punch be "sheared" to cut the middle of the blank first and finish at the corners or ends, the blank will be crooked and larger than the die; but if the die be sheared so as to be highest in the middle and lowest at the corners or ends, and the punch be left flat, the blank will be flat and of the proper size. Shear the die if possible, but if the punch must be sheared let it cut at the ends or corners first. The thickness of the blank is shear enough ordinarily but don't let it begin at a corners so as to form an acurate angle, but let the punch or die be flat back from the corners or ends about two thicknesses of the blank at least.

* * *

Large ratchet teeth from a solid blank may be *sawed* out in two cuts with more economy in time than by one cut of one cutter. Besides, the resistance of a saw will not strain the web of the wheel like that required to oppose the stress from a wide milling cutter.—[A. D. Pentz, in Engineering Magazine.

The Drying Up of the Globe.

Another essential cause of increase of dry land that might be added is the decrease of the ocean itself in consequence of infiltrations of water through the crust of the earth, which is a kind of porous mass, into which the liquid element percolates by innumerable fissures, taking possession of the depths and directing itself slowly toward the center, as the internal fire diminishes and the crusts crack open in consequence. It is understood that the activity of volcanoes and many earthquakes is largely due to this inevitable penetration of the water, which internal heat transforms into vapor under pressure. Some geologists think that the primitive ocean has already diminished in this way one-fiftieth of its volume.

The water is all destined to disappear from the surface of the globe by being absorbed by the subterranean rocks, with which it will form chemical combinations. The heavenly spheres exhibit sufficiently striking examples of such an evolution. The planet Mars shows what will become of the earth in some thousands of centuries. Its seas are only shallow Mediterraneans of less surface than the continents, and these do not appear to be very high; and in the appearnce of the moon, all cracked and dried up, we have a view of the final state of the earth—for the absorption of the water by the solid necleus wtll be followed by that of the atmosphere.—[From The Wasts and Gain of the Dry Land, in the Popular Science Monthly for July.

The New Safety Car Coupler Adopted by the Railways.

In October, 1890, the Committee on Safety Appliances recommended the adoption of the Master Car Builders' type of coupler as the standard of its members. Out of 50 companies voting but two dissented, so it may be said that in 1890 this coupler was recognized by the railroad companies of this country, as their standard, so far as this could be done by their organized action. From statistics recently obtained by this Association we have reason to believe that couplers of the Master Car Builders' type have now been applied to 200,000 cars, or about one-fifth of the freight cars in service, and also to 25,000 cars now under contract. From what is here stated it will be seen that the railroad companies, through their technical officials, have devised a type of coupler which does not require the introduction of body or limb between the cars in the process of coupling or uncoupling. The device is manipulated by a rod, one end of which projects beyond the car body in such a position that it can be safely handled even by a person unaccustomed to its use. The cost of standard couplers, for the 900,000 cars now equipped with link-and-pin couplers, will not be far from $25,000,000.—[H. S. Haines, in North American Review, for July.

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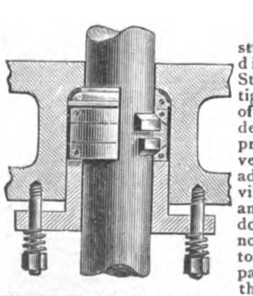

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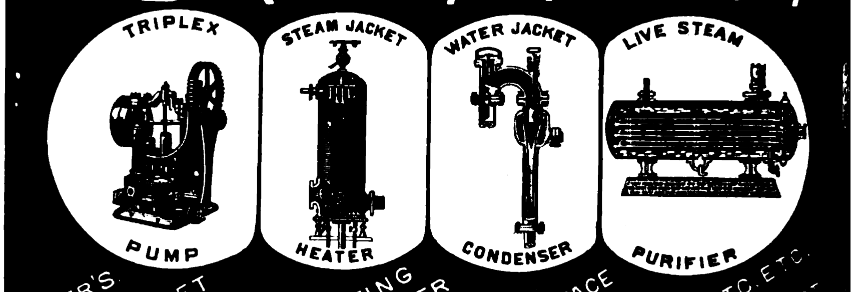

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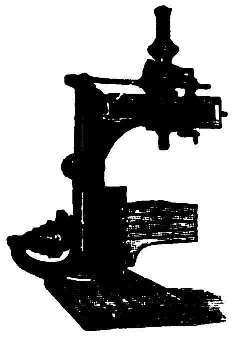

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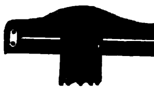

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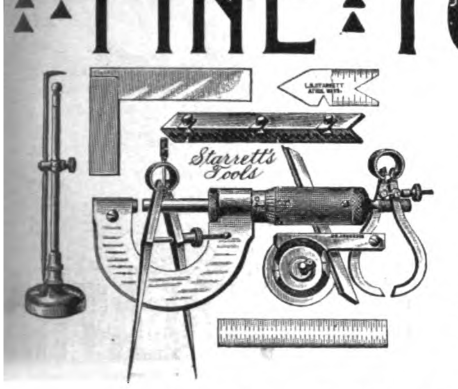

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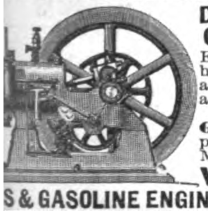

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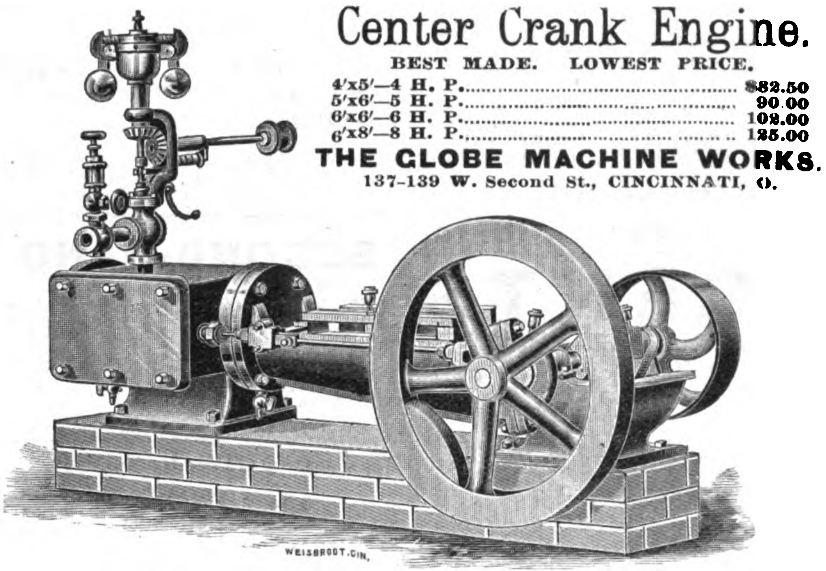
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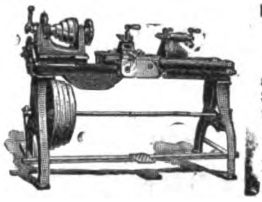

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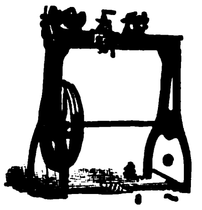

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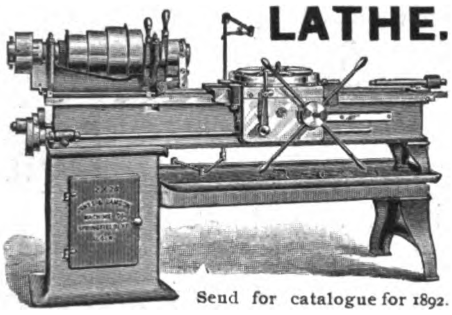

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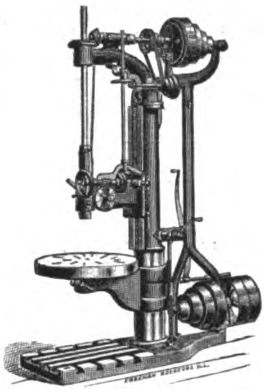

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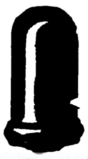

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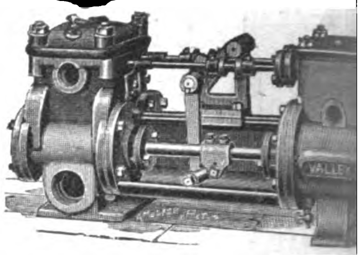

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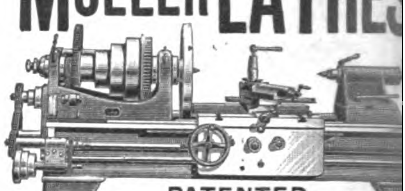

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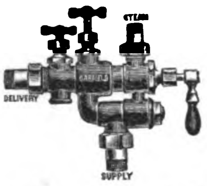

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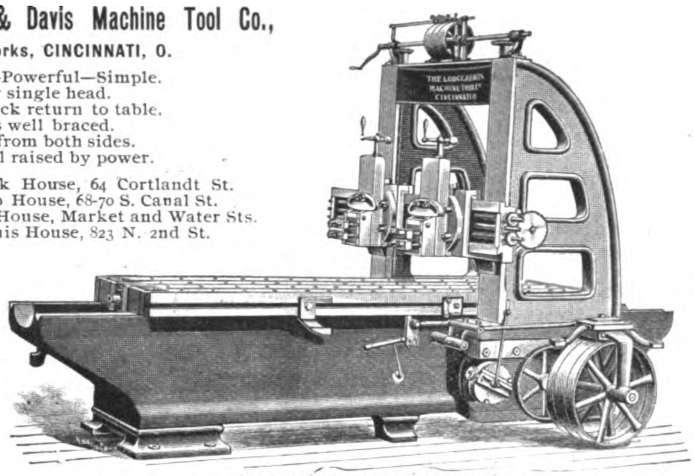

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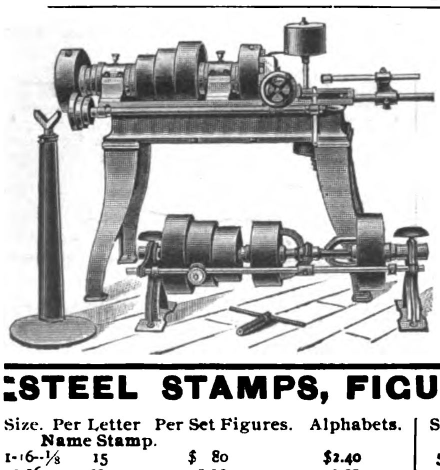

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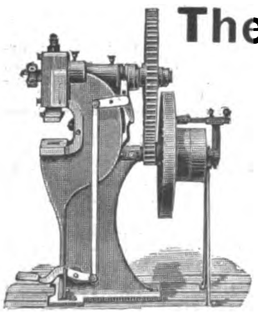

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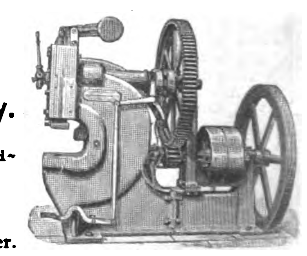

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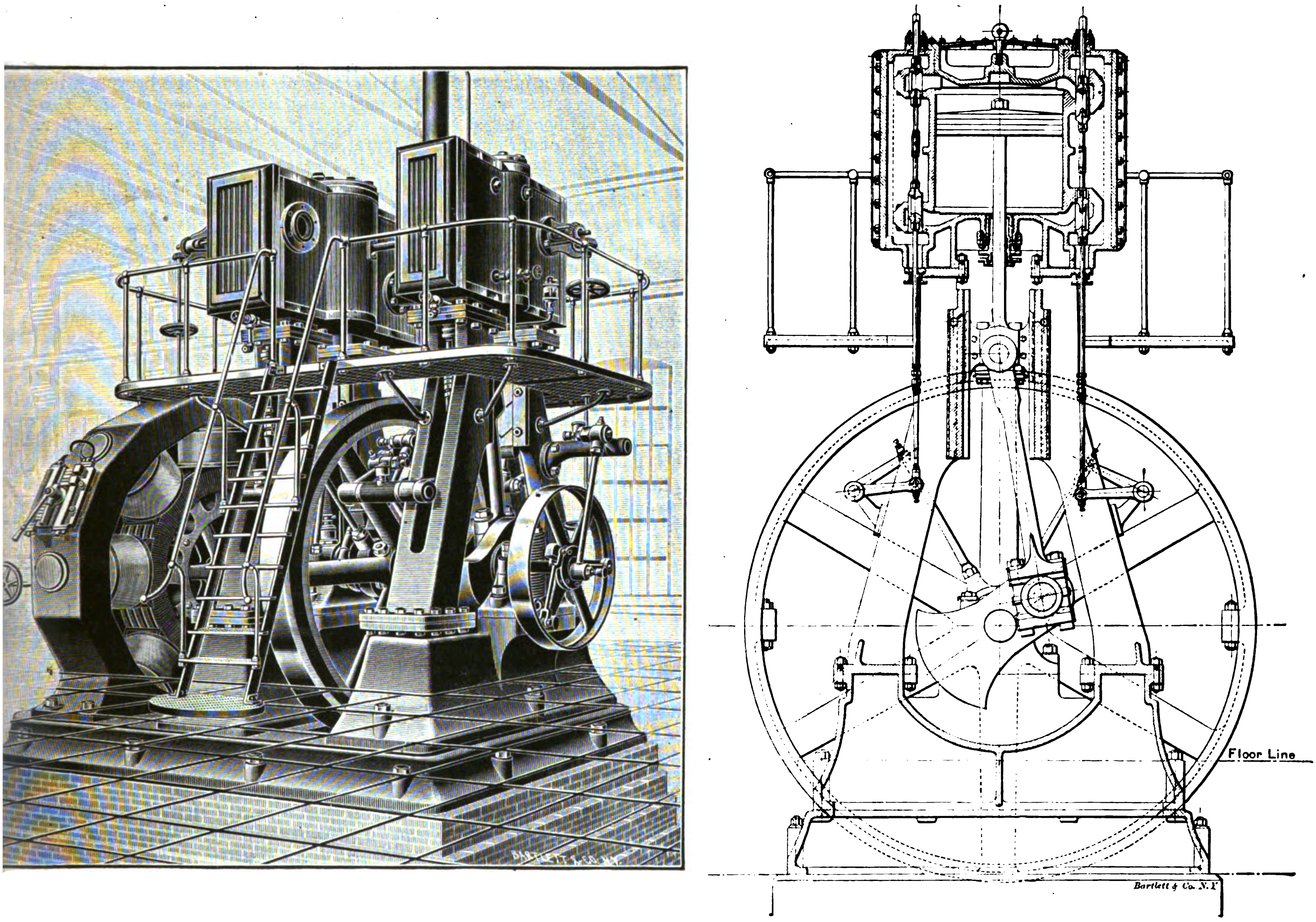
TABLISHED, 1882. CLEVELAND, O., JULY 15, 1892. Vol. X—No. 14. Published Semi-Monthly. Sold by Newsdealers. Terms:—$1.50 a Year, Single Copies, 7 Cents.

DIRECT CONNECTED VERTICAL COMPOUND ENGINE.

This cut represents the standard vertical compound engine, of the ke Erie Engineering Works, Buffalo, N. Y., connected direct to a mul-olar electric generator. These engines are especially adapted for rail-y, electric power and illuminating service, and are built in sizes from to 5,000 horse-power, either compound, triple or quadruple expansion. ey have the reputation of giving the highest economy and regulation, d have the advantage of occupying but small space. The company are ilding several very large engines for direct connection.



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An Electrical Sunrise.

A Twenty-third street theater has brought out an electrical sunrise. A rved screen, part of which is made of gauze, so that the light may shine rough, extends around the stage, and behind it is an elaborate system of candescent lamps. The controlling apparatus is so graduated that 50 dif-rent degrees of light and shade can be produced, thus causing the sunrise grow imperceptibly. Another use of the electric current made at the me place is in representing the explosion of a bomb.

A paper shell contains just enough powder to explode, and make a sh. This is fired by electricity, while at the same moment another cir-it controlled by the same key sets off a gun behind the scenes, which rnishes the necessary noise.—[New York World.

Electric Test for Spurious Coins.

Some interesting tests with alternating currents and a particular form magnet have been made in England. Among the experiments shown as one which illustrated a new method of detecting counterfeit coins. A genuine coin, being a good conductor, was held between the poles of the magnet, but a bad coin, not possessing that necessary qualification, immediately dropped when placed in position.—[St. Louis Globe-Democrat.

The Express Charges More than the Cost of the Article.

We received a letter from a subscriber in the far West recently as follows: "Some weeks ago I noticed an advertisement in the SCIENTIFIC MACHINIST which stated that a new catalogue bound in cloth, containing cuts and discription of all kinds of tools for metal workers, over 700 pages in all, would be sent for $1 postpaid, to any address to any part of the world. I also noticed a mention of it in the book review column stating that it was as represented, so I wrote to Montgomery & Co., No. 105 Fulton street, New York, and sent a dollar for it. In a week or so the expressman called and delivered it. He said the charges were paid, but I asked him what they amounted to and he answered that the rate was $1.10—ten cents more than the book cost. Well, I was surprised at the liberality of Montgomery & Co., and when I came to look over that book I was still more so. There is not a tool or instrument of any kind used by mechanics that is not illustrated in this work. I would not sell mine for $10. But that is not all yet. I happened to want some tools about that time and made up a list, amounting to some $11, and sent it. Well, that firm sold me the goods at standard prices and deducted from the bill the dollar I paid for the book, making only ten, besides prepaying the mail charges. I noticed afterwards that they agreed to do this very thing in the advertisement. The book can't be beat. P. C. DAVIS."

It will be seen by referring to page 14 that this firm are still holding out this remarkable offer. No one interested in tools should miss it.

Practical Letters.

The Two Boilers of A. D. J.

EDITOR SCIENTIFIC MACHINIST:

In reading over your answers to questions in your last issue I find "A. D. J.," of Ishpeming, says he has two tubular boilers set in one arch. One boiler is 4 feet diameter and the other 5 feet diameter. Then he says the small boiler is 18" *lower* than the large one, and he asks what makes the water run from the large one to the smaller. I should say for the same reason that water runs down hill. He also says the steam pipe was 2½", and he changed it to 4", but he does not say if that helped the matter any. He also says that he knows how to remedy that trouble, and that would be by raising the engine up 5 feet and then make the little boiler steam as fast as the large one, and you say his answer is correct.

Now, I ask how he is to *know* when the small boiler is doing this?

You also say the best way to stop the water going to the engine is to put in a dry pan. Now, Mr. Editor, it strikes me that there has been some misunderstanding in this matter or some wild calculating. My theory is that if the two boilers are set in the same arch and connected above by a cross dome and below by a mud dome, leaving as it should a free circulation above and below, that the boilers are set *all wrong*, and he may place his engine on top of the mill, if he chooses, and put on all the dry pans he has, he will still have trouble, but if he will draw a horizontal line across the front of the boilers and then bring the centers of each boiler to the line and have the line perfectly level and connect the two boilers together above and below, with good large openings to each boiler, and then, fire just as he wishes, that he will find no trouble whatever. But, should the water then rise over to his engine, he is either firing the boilers beyond their capacity or the water he is using is where the trouble is. Now, I wish to say, that there is no offense offered whatever, and as we are all after that which is the best, let us solve the problem together, and pick out the good points. FRANK WILCOX.

[NOTE.—Let us hear from others on this question. Discussion brings out much valuable information.—ED.]

The Water Followed the Fire.

EDITOR SCIENTIFIC MACHINIST:

During the cold weather last Winter I was obliged to let the water out of the pipes that connected the pump to the mud drum, into which I feed the water. In order to let the water out I had to close a plug cock next to the drum, and then take the cap off from the check valve, the check valve being about 3" from cock. Through the jar of the check valve all day, the nut at the bottom of the plug cock worked off, and as I went to let out the water, the plug flew out, followed by mud and hot water, of which I got a good dose, but not minding that, I started to pull out the fire and raise the safety valve ball, which held down 40 pounds at the time. By the time I had the fire out, the water was coming that way, too. Since that time I don't monkey with stop cocks until I see that they are all O. K. Now, Mr. Editor, if you think this of any value to the many readers, you will publish in your excellent paper. F. A. W.

Where to Get a Book on Perpetual Motion.

EDITOR SCIENTIFIC MACHINIST:

"Inquirer," in your issue of March 15, does not appear to meet with much success in gathering from your correspondents information on past attempts at "inventing" perpetual motion. Probably what he seeks can be found in a book published by Munn & Co., New York City, entitled "Perpetual Motion."

"The Old Man" sneers at such inquiries, but condescends to tell how a p. m. "crank" furnished a good, fat job for him—or his boss. If *all* inventors would, as far as practicable, ascertain what has been done before them in the line of their would-be inventions before devoting time, work and expense to their development, I think much useless trouble and heartache on their part might be avoided. E. M.

Feed Them Separately.

EDITOR SCIENTIFIC MACHINIST:

I notice the question of "A. D. J.," Ishpeming, Mich., and your answer. I judge that the boilers are connected. The dry pan plan is good, but if it does not work, I would, in case they are connected as stated above, feed them separately. Will the brother write to the editor of the SCIENTIFIC MACHINIST, when he has found a way out of his difficulty, and tell us how he did it? We always like to know the outcome. S. B. S.

Automatic Gas Burners.

EDITOR SCIENTIFIC MACHINIST:

In your issue of May 1, I see an article mentioning a gas burner that shuts off automatically when blown out. There are two inventions of that kind in this country, that I know of, both invented by New York men. One works with a spiral spring, the other, invented by Wm. Hodgson, of New York City, about two years ago, works about the same as the London invention, with the exception that his has a spring made of copper and steel instead of German silver and steel. J. E. HODGSON.

Thanks, Mr. F. S.

EDITOR SCIENTIFIC MACHINIST:

I wish to say to Mr. "F. S.," in regard to the answer to question 354, in April 15 issue (his answer in May 15), that I am very much obliged for his kindness in giving me a remedy for my slide valve. Had it not been for your "Questions and Answers" column I would not have learned what I did. FRED A. WITZLER.

MACHINE SHOP NOTES.

The cost of manufacture depends, in modern practice, inversely o the quantity required to be made of any one thing within a given time. Fo instance, a complicated, knurled-headed and necessarily very accuratel sized screw, perhaps two inches long and one inch in diameter would cos $3 each for labor if made one at a time with the tools guided by hand in a engine lathe, but if 50,000 of them were wanted in a year, an automati screw-machine could make them for less than two cents each for labo alone.

* * *

After engineers have become tired of all kinds of complicated an expensive bearings for machine-spindles they will all come to the conclusion that the cylindrical bearing is best if it be housed within a split journa box. Furthermore in most cases they will prefer a cast-iron journal. Whe however, they prefer something better, it will be a bushing within this spl journal box of hardened steel flanged on one end to meet the greater thrust This hardened bushing will doubtless be split at the point diametricall opposite the split in the housing of cast iron.

* * *

K. R. J., Methuen, Mass., asks: "I have been trying to lacque some electrical instruments, but after the varnish dries it peels off. Th trouble is not in the varnish, as I buy that from a good dealer who sells i to others who use it without trouble. What is the matter? The deale doesn't know." And we don't know for certain; but most probably th cause is that you applied it when the metal was cold. If you will warm th metal to about 210° F. or 100° C., and if the lacquer is made of shellac an alcohol, you will find it to adhere perfectly and it will dry at once.

* * *

An acquaintance of Duddler some months ago became interested i an invention and took the model and drawings to the latter's shop to ge his opinion of it as an expert mechanic. Duddler thereupon spent half day in confirming the general opinion that his acquaintance was quit sound financially. Then he looked the device over in company with hi foreman and he persuaded that person that it was a good thing; or at leas it would be good if it was to be made at Duddler's. That invention is sti there, where four men at 60 cents an hour have been working at it unti within a week or two. It is, however, now permanently laid aside a failure. The acquaintance damns all inventors, pays his last bill an departs; Duddler, however, is complacent.

* * *

Tom, the foreman, gave a piece of work to the boy Max to fini which was of a better class than he before had done. The boy spoiled i but said that Dick Knight had wrongly instructed him about it. It was job that Dick usually had done, and there were circumstances that pointe to the truth of Max's tale that he had wilfully caused the boy to do b work. Dick was discharged, and four men who sympathized with him di not come to work the next day, nor, in fact, for a whole week. The one after another, they returned to work, explaining that they had bee sick. Incidents of this type happen every day, and to those whose ide tend toward the advancement of the manual classes, they go far to reconcile them to things as they are.

* * *

Experiments made several years ago convinced me that both ends o a milling machine spindle could be used advantageously, and two operations could be done on it together, thus effecting a saving. While one cu was being operated on a piece in a fixture on one end of the machine, th piece that had been cut on the other end could be removed and anothe could be inserted. The chief difficulty in thus running a spindle continuously while work is being returned under a moving cutter is that the previous cut will be marred and the cutter itself will be injured. If, however each slide can be arranged so that it will drop when it is moved backward and rise, when it is fed forward, like the four-motion feed of a sewin machine, this objection will be overcome. The mechanisms to do this i a number of ways have been designed for other things, and it strikes m that this modification could be effected easily by any good mechanic.

* * *

The same quality of foresight which provides materials for next month' work should lead manufacturers to provide skilled mechanics for the nex generation of workmen. If boys in machine-shops had not in the pas been a paying kind of labor it is extremely doubtful where or how machinist would have been instructed in that which they are expected to know At present there are rather more skilled workmen than there is employment for, owing to the rapidly increasing use of self-guiding tools that require no mechanical skill to use them and which may as well be operate by one person as by another after a few hours of instruction. But thes men who now are in abundance will grow old, and the trades unions ar limiting the number of apprentices. Hence, unless there is other provision now made for the education of their successors there will in time be scarcity of good men and an era of high wages that will be very gratifyin to such men as then may have a sound practical training.

* * *

A real-estate lawyer and a mechanical engineer both do business i New York City and they are neighbors and acquaintances in the country.

GRAPHITE PAINT

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The lawyer not long ago had made a blue-print frame to copy maps and other tracings that come into his temporary possession. He had difficulty in getting clear lines, and on the train one morning he stated his trouble to the engineer who explained the necessity of a close contact of the tracing to the sensitized paper over the whole surface. Presuming on this assistance, the engineer a month afterward asked the lawyer a legal question relating to a leasehold. The legal man could not answer on board the train and invited the engineer to his office, where the desired information was given in ten minutes. On the first of the next month the lawyer sent in his bill for the advice. Then the engineer sent in a bill for a similar sum for his advice. The lawyer says it is "ridiculous—friendly talk on the train—don't remember much about it, but never heard of a bill for a little simple thing of that kind." Now why is it ridiculous for a mechanic to charge reasonably for professional advice?

* * *

Blunt, some years ago, found that his shop—then a smaller affair than t is today—had become stagnant. He was making money, feeling "good" and inclined to be generous to his employes. His men were satisfied, steady and loyal. They all worked along in the groove to which they were habituated and each produced about so much good work every day. One morning the mail brought the news that Keen, who made the engine hat competed, had cut his prices so much that unless something was done o meet it Blunt's shop would have to close or lose money. That afternoon Blunt went to the city and carefully examined one of Keen's new engines and was both surprised and humiliated to find that it was a better machine than his own. It had a whole suit of new improvements, patented of course; it had new patterns throughout, the whole design harmonized well, making a symmetrical appearance, and it was warranted to be more efficient to an alarming degree. The only drop of comfort that Blunt could get out of this condition of affairs was that Keen was not quite ready o take orders for the immediate delivery of more than one size of engine. During the next month, one after another, there came six new draughtsmen into Blunt's office. Then his pattern-shop was filled with the best help he could find, and much work of this character was sent out to jobbing-shops. It took three years for Blunt to catch Keen, and it cost him a great deal of money; but it has taught him that no manufacturer can fford to go to sleep in prosperity.

* * *

B. Y. M., Brooklyn, N. Y., asks: "Will not this plan overcome the difficulty of soldering to cast iron? Brighten the surface that is to be soldered and then rub on it a piece of bluestone, which at once plates the iron with copper. This is a kind of electric-plating business? Then, as older easily flows on copper and sticks to it, two pieces of cast iron should s certainly be well soldered to each other as two of copper?"

It is true that a bright surface on cast iron can be coated with copper in the way you state, but it is not technically an electrical effect. "Bluetone" is the sulphate of copper, *i. e.*, sulphuric acid saturated with metallic opper. Now iron is much preferred to copper by this acid, so much so hat it will leave the copper entirely to combine with iron or zinc. Hence, when the bluestone is wet with water and rubbed on bright iron, the acid eserts the copper and combines with the iron, leaving the copper in a metallic state and in a thin coat on the bright surface of the iron. Under his coat of copper, then, there is a thin film of sulphate of iron made by he acid which has left the copper and attacked the iron, so that there is no reat union between the two metals. If the rubbing of the bluestone be epeated a number of times the metallic copper color will disappear and the reen "copperas" or sulphate of iron color will take its place. It is possible that the thin coat of metallic copper on cast iron may freely be soldered; ut it is problematical whether there is anything to be gained by it as the weak joint then would be between the copper and the iron, or in the thin ilm of iron sulphate which has but little cohesive strength in itself and can ave no firm adhesion to either of the metals it is in contact with.

* * *

In packing machinery for sea voyages that are to extend over a long eriod of time, it is always to be feared that the iron and steel parts, espeially if they are bright, will be damaged by rust due to the vapors arising om sea water. White lead is often used to smear the bright parts with, ut if the voyage is to be through torrid climates the lead in drying will ecome so solid and hard that it is removed with great difficulty if without njury to the surfaces. The cylinder oils and the greases that are prepared r smearing purposes from petroleum products sometimes fail to retain heir hold on bright surfaces in a continued high temperature such as would e experienced in a voyage to Brazil, Chili, South Africa, or Australia, nd such parts as become bare will rust. It is doubtful if anything which an be applied cold will retain its hold if it is not of such a character as to arden like a varnish or paint to the surfaces it covers, in a hot climate. Now because one fact of experience is worth a thousand theoretical conectures it may be well to state how hundreds of thousands of fine machines ave been sent to Australia, arriving there in perfect order as far as rust as concerned and without being smeared with anything farther than what needed for the domestic trade. This method is entirely a matter of the ox or case in which the machines are packed. The bottom, top, two des, and two ends of the box are first formed as independent pieces, of iln-dried pine lumber, and each one cleated so that they hold together as eparate pieces, and the cleats are placed so that they reinforce the box hen it is nailed together. In very heavy cases these cleats entirely surround these sides, etc., making a panel of each of them. When these ements are finished, so that they would make a neat box if they were ailed together, each is painted on the flat inner sides with a coating of hot ack asphaltum, which melts at about 214°. Then at once on to each of hese coated surfaces is pressed a sheet of thick tough paper, which of ourse sticks firmly to the pitch. These sheets of paper are so shaped that here edges shall be held within the joints of the box when it is nailed gether. Thus each of the two end sections will have paper turned over heir four edges; each of the two side sections will have it turned over the two edges that receive the cover and bottom sections only; and the bottom and cover have the paper laid only on their flat sides and not turned over the edges at all. Then a second coat of the hot pitch is applied to all the exposed surfaces of the paper on all pieces except the cover. It is nailed together while hot and the joints are carefully payed with additional pitch. Into this case the goods are placed and protected with wrappings, then the cover is coated with the pitch and nailed on. This is the best form of "tar-lined" box. Cotton thread is often sent to sea in boxes lined with tin soldered tight; tea is always shipped from China in lead-lined chests and small parts of machines might be sent in such boxes as these; but in large cases this metal lining probably would be found too expensive.—[A. D. Pentz, in Engineering Magazine.

NEW EXPERIMENT IN STEAM PROPULSION.

A boat with two screws, on the bottom, amidships, invented by F. W. Richardson, says an English journal, is soon to be tried. A successful trial has been made in an old vessel, and now the company have intrusted Messrs. Cochrane, Cooper & Schofield with the order to build a new vessel specially adapted for the purpose. The vessel will have the following dimensions: Length between perpendiculars, 94 feet; breadth 18 feet 6″ depth of hold, 8 feet. She is to be fitted with two pairs of compound surface condensing engines. The tube in which the propeller works is a complete tube for about five or six feet, and then it tapers down to the keel, the forward end at eleven and the after end at eight degrees. The advantages claimed by the patentee for this system of propulsion over the present stern propeller are as under:

1. Economy of power, and consequently saving of fuel.
2. Direct action between the steam and the work.
3. Enormous reduction of weight in all moving parts, together with general lightness and compactness.
4. Variable immersion, so objectionable in the present system of propulsion, will not affect the principle.
5. Immunity from rocking and straining of engines.
6. Risk of fracture of crank or propeller shaft minimized.
7. Less noise and vibration, consequently a much more comfortable passenger boat.
8. When reversed the vessel will move straight astern without divergence.
9. No swell or side-work to destroy canal banks, owing to the currents moving straight astern.
10. By altering the relative speed of the engines, the vessel can be safely navigated in the event of rudder being carried away, or steering gear disabled.
11. Safety and steadiness in the event of the ship being hove to, with perfect command under all situations.
12. War vessels can be built double-ended, with power for ramming increased.
13. Greater facility for handling the ship, with full engine power for maneuvering.
14. Safety of the propeller power from harm.
15. Avoidance of risk of detention from accident and adjustment of the machinery for both screws at the same time.

THE PRICE OF GAS IN CLEVELAND.

"Last Summer the city government of Cleveland made an attack on the gas companies, compelling a reduction in price from $1 to 60 cents per thousand cubic feet. The controversy over this affair served to attract public attention to the subject of street-lighting, and incidentally to the question of the municipal ownership and management of electric lighting plants. Throughout the State of Ohio public opinion at the present moment appears to be running very strongly in favor of this socialistic policy, and a considerable number of towns, with a population in some instances of even less than 1,000, contemplate issuing bonds and going into the electric-lighting business. Probably there is no way to cure this craze except to let it run its course. * * * We predict that before ten years have passed most of the municipalities owning an electric plant will be only too glad to make a present of the outfit to any party who will give a bond to maintain and operate it at reasonable charges for service. There is no known industry in which so much money can be wasted fruitlessly by municipal ignorance in so short a time as in the production and distribution of electricity."

The above from the *Engineering Magazine*, must have been written some time ago. We have no comment to make on their ideas regarding misguided public opinion on the question of the cost of electric lighting, but the statement of the status of the gas controversy in Cleveland is somewhat at fault. The Council passed an ordinance reducing the price of gas from $1 to 60 cents per 1,000 cubic feet. The company fought it in the courts all Summer and Winter. The United States Court was engaged for many weeks in taking testimony. City Solicitor Gen. Ed S. Meyer proved from the mouths of the gas company's witnesses that gas could be made in Cleveland and sold at a profit for 60 cents per 1,000 cubic feet. What he might have shown had the city witnesses been examined and its testimony taken, will never be known by the public, for the gas company became frightened and made a gigantic and successful effort to compromise the suit. As a result, the price of gas in Cleveland is now 80 cents per 1,000 cubic feet, and the gas company pays 6½ per cent. of their gross receipts into the city treasury for the use of the streets, and as an acknowledgement that they have a great snap.

The compromise was not satisfactory to a large number of citizens, but it has started the agitation for cheaper gas, and municipal corporations in every State may be expected to take up the fight. Cheaper gas means a very great saving to manufacturers, large and small.

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It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, JULY 15, 1892.

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OF INTEREST TO STEEL WORKERS.

Each kind of industry undoubtedly has its native clime, where it can be most easily propagated at the greatest profit to the producer. How shall we know the respective home of each industry? It has been said that Massachusetts was the home of American cloth fabrics. It has also been declared that Pittsburgh was the center of iron manufacturing. There must have been some reason for these assertions, if nothing more than the product to base the statement. "The proof of the pudding is in the eating," they say.

Well, let us see. Within the past few years Chicago has produced so much finished iron that it has earned the name of a great iron center. The question arises, if iron can be finished economically from the pig in Western cities after the transportation of the ore East and return of the pig, why can't the pig be a Western product with much greater profit? The iron must be finished in the West principally because the freight on Eastern coal is cheaper than the freight on finished iron.

Therefore, if this be true, and if the Western iron workers are making finished iron profitably, after hiring labor at as high or higher prices and paying freight and commissions on fuel, why should they not make much greater profits by keeping the raw ore at home, and bringing all the needed fuel to the Western iron fields for the manufacture of every iron and steel article of Western consumption? It is no more sensible to ship ore to Pittsburgh for smelting than to ship saw-logs to Boston for sawing. This argument must effect the Western lake port iron industries at least. Nearly all of our Bessemer ores are found in the vicinity of Lake Superior, the most extensive and the richest beds of steel ore in America, having been discovered lately within 50 miles of the head of navigation on that lake, which stretches farther west by 300 miles than any other. The wheat fields of Dakota, Manitoba and Minnesota attract hundreds of vessels to Superior and Duluth laden with coal as ballast at rates ranging all the way from nothing up to $1.25 a ton, the average being 30 cents. This has induced many steel industries to locate at Duluth and Superior.

The mere fact of the location at West Superior of the Whaleback Steel Barge Works, is evidence of our assertion. This great institution, which has in its employ over 1,200 men, sensibly selected a spot on the "Inland Ocean," not as near the coal beds of Ohio and Pennsylvania as possible, but as near the inexhaustible Gogebic, Vermilion and Mesaba steel ore ranges as they could get, and at the wheat and coal metropolis of the Northwest. What has followed their example? Why, the West Superior Iron & Steel Co. with one of the largest plants in America; the Superior Malleable Iron Co., the Standard Iron Works, the Superior Steel Co. (edge tools), the Marinette Iron Works, the York Steel Plant, the Superior Stove Co., Burdick & Hewson Cornice & Roofing Co., West Superior Smelting & Refining Co., the Minnesota Car Works, and many others, all dropped in so suddenly as to create almost a revolution in the steel industry of the world.

The assay of the ores there mined averages nearly double the value of ores in other localities, and it lies so near the shore of Lake Superior an so near the top of the ground as to make the cost of mining and handlin very small.

An eminent member of the American Iron Workers Association ha made the following comparison of the cost of making pig iron at three lak ports.

	West Superior.	Cleveland.	Chicag
One ton Vermillion ore	$4 50	$4 50	$4 50
Freight	....	2 09	1 30
Dock charges or transfer	20	30	30
One-half ton Gogebic ore	2 08	2 08	2 08
Freight	26	1 04	78
Dock charges or transfer	10	15	15
One ton coke at furnace	5 50	3 50	5 50
Total	12 64	13 51	14 61
Deduct saving Mesabs	1 20		
	11 44	13 51	14 61

But the *American Land and Title Register*, of June, 1892, declares th "as a matter of fact, coke can be made at West Superior and delivered the furnace at a cost of $5 per ton." The same journal adds, that the tab of Mr. Birkenbine, given above, has never been disputed by a steel make Indeed Mr. Andrew Carnegie has said that steel making must move we ward nearer to the ore beds. It did move as far as Chicago, as witne the enormous capitalization of the Illinois Steel Co., exceeding that of a other in the world. It must move again northward, and is doing so. W Superior has more than doubled its population in the past two years a can count now over 5,000 men engaged in its iron and steel industr from less than three years growth, while Duluth can count nearly as ma from five years growth.

We can therefore safely predict that unless some unforeseen tariff coal arises, whereby it should be made profitable to again cart the ore E and the finished product West, that the cities at the head of Lake Superi must become very soon the great steel manufacturing center at least the vast Western markets, but probably for the whole North Americ continent.

STRIKES WITHOUT ANARCHY.

In regard to the Homestead difficulty we have this to say, that one the principal causes of serious difficulty between employers and emplo in any line of manufacturing is a misunderstanding grounded upon su cion. And much as we sympathize with workingmen in their effort retain a living recompense for labor, we can not say it is to their interest rob other men of their legal rights in order to realize their own ambiti nor is it at all necessary. The late success of the striking street car ployes, of this city, proves beyond question that the peaceful means is best means.

William Lovett, principal founder of labor organizations in Engla although persecuted by the laws of the kingdom, was one of the m loyal men of his day. The reputation of strikes was established under direction. Our own Powderly is, although he sometimes goes off pre turely, a man of the same stamp, not an anarchist, but an organizer the co-operation of labor. And the sooner we can all come to the me ods of these loyal men the sooner will co-operation recommend itself to whole world of working men. But with violence and blood-shed in lead, we can not hope to enlist the sympathies of law-abiding citizens have established interests at stake in the supremacy of government. operation should be for the purpose of influencing our legislators to en laws to our advantage, and not for the purpose of making laws for occasion ourselves, in the face of laws which we have already subscri to as citizens.

There is one remedy which we have often before suggested for su evils as labor wars, and that is such a system of restriction of forei immigration as shall exclude the pauper competition of Europe and A to which we might add a compulsory education and civilization of th we have already admitted.

Tapped Electric Light Wires.

Gustav A. Tempel, the first man ever tried on the charge of steal electricity, has been discharged in the court of criminal correction Judge Claiborne. The judge would not concede that the offense was p larceny and the grand jury would not allow that it was fraud, so when case came up, Attorney McDonald, for Tempel, entered a plea for forr acquittal, which was concurred in, and the defendant discharged. Temp who is a hard wood dealer, was accused of having tapped a wire of one the electric light companies to get his illumination free.

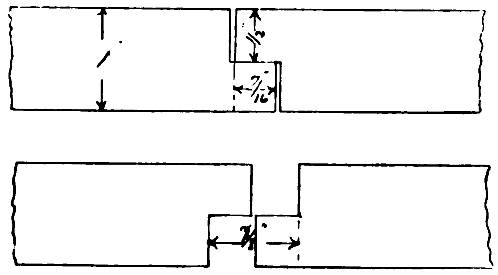
Compress Heater and Sterilizer.

A useful appliance has been introduced in hospitals in the shape c compress heater and sterilizer. There is no moistening or wringing of cloths necessary. It does away with the use of oiled silk or cotton, a cannot wet bed clothes and will retain heat longer than the ordinary co press, and the compresses may be applied to different patients with washing, as they may be easily sterilized and freed entirely from germs. [New York Telegram.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and ientific subjects of a practical nature and of general interest will receive attention. The iter must give his name in full, but nothing that may identify him will be published with uestion if he requests his name withheld. It will give the editor pleasure to assist, through is column, all readers, if possible, and he cordially solicits practical queries.]

(396.) F. P., Macon, Mo., writes: "I would be pleased to have u tell me how cylinder rings or steam piston head rings are cut to make e parallel joint quite tight. What I want to get at is, how is the parallel t made so as not to lose stock?" *A.*—Turn the rings about ⅛" larger an the diameter of the cylinder, and saw them entirely through in one ace, and cut out ⅜" on each side, as shown in the illustration. They e then sprung in place.

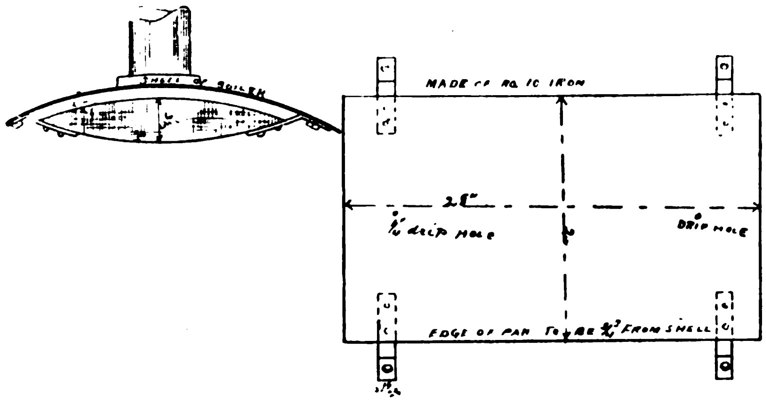


(397.) F. A. W. asks: "I have about six months to spend after ugust, which I would like to spend at school. Will you advise me what study to become a good engineer (if I act my part) either for stationary marine." *A.*—We would advise you to place yourself in correspondice with the various engineering schools and ascertain what arrangement in be made for taking a number of lessons or a brief course in some partment most useful to you, in the short time you have at your disposal. ou probably know that six months is too brief a time in which to carry rough, successfully, much of a course. It would be wise for you to take ore time, if possible. If you take a year you will stand a good chance earning enough more the next year to pay for the time lost. If you ant to study marine engineering, we know of no way but to go on a eamboat as fireman or greaser.

(398.) C. W. Grant, Paris, Ill., writes: "Will you please inform e how to charge a magnet taken from a battery. I have tried to charge on both my dynamos, both magnetive and positive, and as I take the agnet away from the field it loses its magnetism. I thought that the achine was too strong. Would a weaker current charge it?" *A.*—You obably have a piece of soft iron. A permanent magnet can be made of thing but steel.

(399.) F. M. B., Tacoma, Wash., writes: "We want to put in a rger engine, if our boiler will run one any larger. We have used low essure, and do not know how much more pressure can be put on. ease tell us how to get at this. Our boiler is 5-16" steel shell, 16 feet ng and 60" diameter with 46 4" tubes. It is two years old, and has been ed carefully. What horse-power engine will it supply, if evaporation is ept at the maximum for safety?" *A.*—The United States government le for figuring boiler pressures is to take ⅙ of the tensile strength of etal as a safe working pressure and divide this by the radius of the boiler inches. Example: Assuming the tensile strength to be 50,000 pounds, of 50,000 = 8,333 ÷ 5-16", or thickness of plate = 2,666 ÷ 30" or dius of boiler in inches = 88.88 pounds allowed on boiler. This boiler the above pressure and everything working good otherwise should rnish steam for an engine developing 75 h. p.

(400.) Wm. McDonald, Leavenworth, Kan., writes: "In your sue of June 15, in answer to correspondent, you say the best way to stop ater from going to engine is to put a dry pan under the opening in the eam pipe. Would it be asking too much to send me a little description this dry pan by return of mail, as we are troubled a good deal in this espect. Our engine is much below the level of boilers. We are going to hut down in a few days for some repairs on boilers, and thought it would e a good time to put in this dry pan. How far from the opening should be placed?" *A.*—The accompanying illustration answers this question. t shows the position of the dry pan in the boiler and gives instructions for utting it in.



(401.) C. P. Milling Co., C. P. N. G., writes: "I have hard work getting steam. Boiler is a 50 h. p., two flue. A neighbor says that my draft is not right. Please give me the rule for finding the proper chimney draft for a boiler of this size." *A.*—The stack should be about 1¼ times the combined area of tubes and 15 feet higher than the surrounding objects.

(402.) E. F. H., Benington, Vt., writes: "Will you kindly settle an argument between a shop mate and myself as to the existence of the so-called steel rail worm? I say that it is just a sort of by-word. Will you kindly tell me through your paper if such a worm does exist, and if not, the origin of the story?" *A.*—We shall be obliged to refer this to our readers, not knowing anything about it.

(403.) Stockwoods Mill, ——— Mo., writes: "We shall soon run a saw mill in connection with our floor mill, and the slabs, scantlings, sawdust, etc., from the saw mill will not suffice to keep the two boilers going. Can we burn this mill refuse a week and coal a week, changing off and on, in the same furnace?" *A.*—Although the grates and air space in furnaces designed for the most economical burning of sawdust, slabs, etc., and coal, and although, theoretically, these two fuels cannot be burned in the same furnace, yet they are very frequently. Your grates should be of medium fineness. We would advise you to burn your wood and coal mixed instead of burning one kind one week and another kind the next.

(404.) E. G. S., Columbia, Pa., asks: "What are the names of the leading German mechanical papers and where are they published?" *A.*—The principal German mechanical periodicals are as follows: *Der Maschinenbauer* (Leipsig), price per year, $4 35; *Machaniker Zeitung Deutsch* (Hamburg), price per year, $1.35; *Zeitschrift des Vereins Deutscher Ingenieure* (Berlin), price per year, $10.70, and *Uhland Skizzanbuch* (Dresden), price per year, $3 35. The names were procured from a publication recently printed by C. A. Rhode & Co.

(405.) Burt Crebbin, of Sherman Heights, Tenn., writes: "I have charge of a Corliss engine that has a large amount of bright work which the former engineer let get very dirty, and it is hard to clean it. I tried emery paper, but that scratches it, and besides it is a hard matter to get at some of the parts to clean them. Can you tell me how to get it clean? Is there anything that will eat it off without injuring the metal in any way? By answering through your valuable paper you will greatly oblige a reader." *A.*—Use kerosene oil and water-lime mixed. The proportions are a matter of indifference or discretion. After applying, wipe dry.

CONCERNING DYNAMITE.

Very few people have a correct idea of what dynamite is, of what it is made, and the uses to which it is put. To the French belongs the honor of its discovery and its practical use.

Nitro-glycerine is the force of all high explosives. Dynamite is the name most usually given to these explosives, though other names are sometimes used.

Dynamite is simply nitro-glycerine mixed with various ingredients. Nitro-glycerine is made by mixing sulphuric and nitric acid with sweet glycerine, the same that is used by the ladies to prevent chapped hands. Mixing the acids and glycerine is where the great danger lies in the making of nitro-glycerine. The mixing tank, or agitator, as it is called by dynamite makers, is a large steel tank, filled inside with many coils of lead pipe, through which, while the mixing is in progress, a constant flow of ice water is maintained. This flow of ice-water is used to keep the temperature of the mix below 85°, as above that point it would explode, and a hole in the ground would mark where the factory had been. The nitro glycerine is stored in large earthenware tanks, which are usually sunk in the ground to guard against blows or severe concussion.

The other ingredients for making dynamite are: Nitrate of soda, which is found only in Chili, carbonate of magnesia, and wood pulp.

Dynamite is put in paper shells usually 1¼" in diameter, and 8" in length, and weighs about one-half pound to each shell or cartridge. It has largely taken the place of black powder for blasting, as it is many hundreds of times stronger, and consequently more economical. It is used chiefly in mining all kinds of ores, coal and rock, and submarine blasting and railroad building. Without its aid many railroads, especially those crossing the Rocky Mountains, could not have been constructed; without it Hell Gate, in New York harbor, could not have been destroyed, and without it the miner, at prices now paid for mining ores, could not earn his bread.

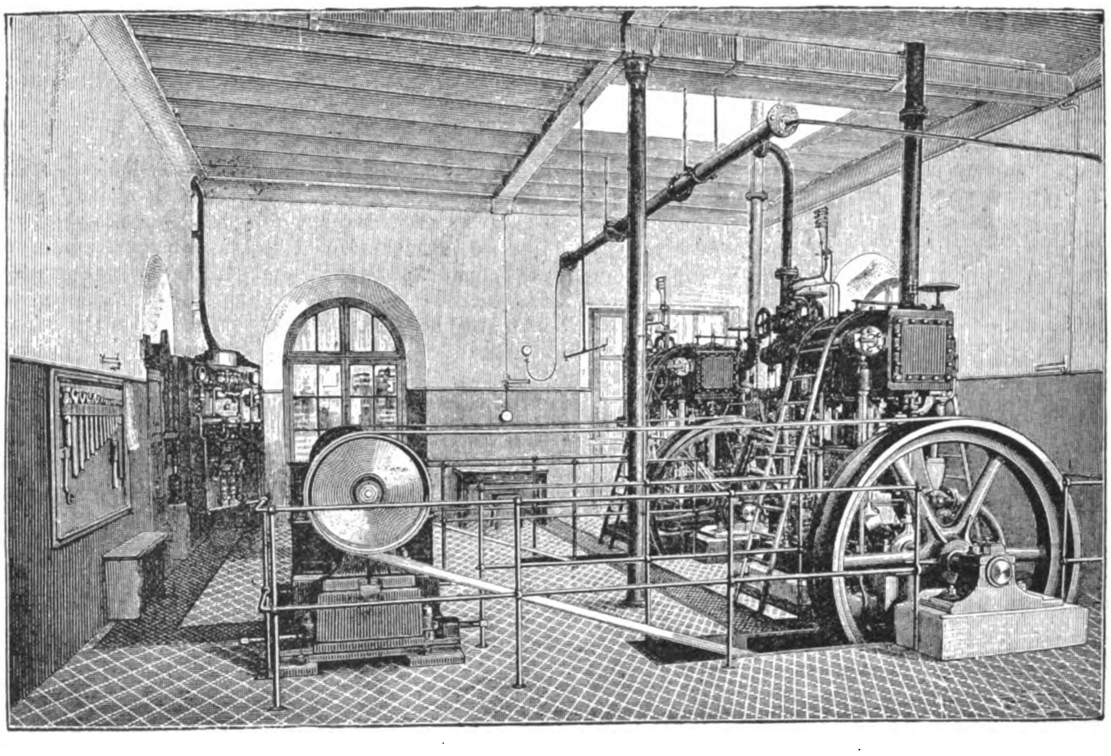
Dynamite will not explode from any ordinary fall or jar; it will burn without explosion, and freezes at 42°, 10° above ordinary freezing point. The bomb of the anarchist is made of metal or glass and filled with pure nitro-glycerine arranged so as to explode by severe contact with any hard object. These bombs are, of course, never made by a reputable dynamite factory.

Five or six millions of dollars are invested in the manufacture of dynamite in the United States, and its use is constantly on the increase. The fumes of nitro-glycerine produce intense headache, which can be cured by taking a very small dose of it internally.—[Detroit Free Press.

It is stated in the New York *Sun* that the rudder of the French ironclad Brennus, launched some time ago at Lorient, was 18 feet high, 13 feet wide, and weighed 17 tons. In transporting it from the shops where it was made to the shipyard, it was necessary to suspend it between two flat cars, as it could not be placed upon a single car in any position, even by this latter arrangement the rudder just clearing the roadbed and the arches of the tunnels through which it was necessary to pass. This great rudder was built with an interior framework of wrought steel, iron angles and plates, and covered with steel plates, extraordinary care being taken to have it perfectly waterweight.

ELECTRIC LIGHT PLANT AT MONTE CARLO.

The principality of Monaco, with its population of 8,000 persons, supports two electric light stations. The principal customer of the Societe des Bains de Mer et du Cercle des Etrangers is the Casino, with its hundreds of brilliant lights. The station is located on the east shore of the little harbor of Monaco, about a quarter of a mile from the gaming resort. The plant is rather small, and is arranged in three units. The boilers are of the tubular type, and coke is burned under them. The engines are vertical, compound, condensing, and each is capable of developing 90 horse-power at a speed of 150 revolutions per minute. The three dynamos are Ganz direct current machines, each of a capacity of 48,000 watts. Two of the engines and generators are shown in the accompanying illustration. Current is carried from the station to the Casino by a 60-wire lead covered cable buried under the pavement in a wooden trench. Proceedings would of necessity come to a sudden stop at the Casino should darkness fall upon the game. If it should continue for many minutes the experience would be very trying on the nerves of the players. The palatial structure has, therefore, been connected with the second station in Monaco, where Ganz alternators are operated. A bank of transformers is located at the Casino, and if the continuous current should fail, the alternating current is available to light 1,000 lamps. The illustration is reproduced from *L'Electricien* by the *Western Electrician*.

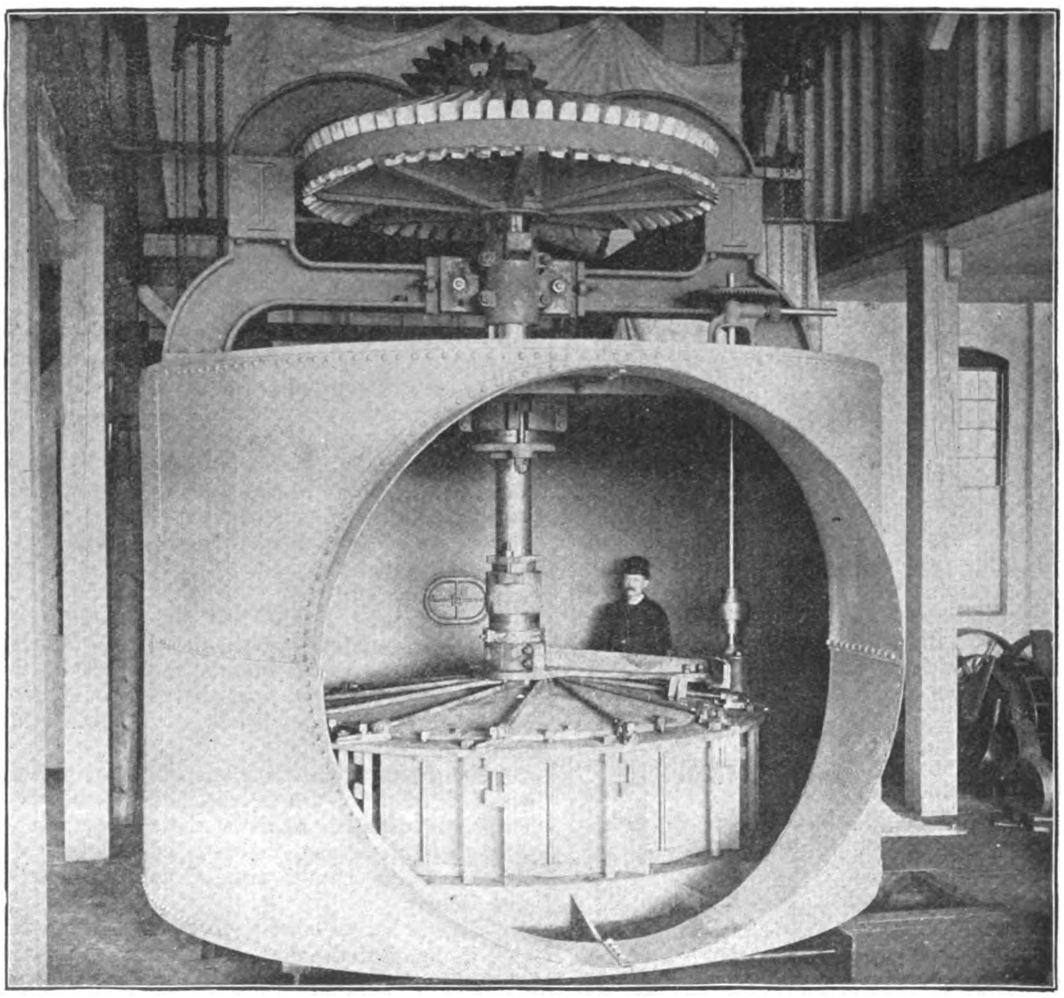


ELECTRIC LIGHT PLANT AT MONTE CARLO.

A MAMMOTH WATER WHEEL.

We present herewith, an illustration of an enormous turbine water wheel, recently built by James Leffel & Co., of Springfied, Ohio. This wheel was supplied to a large lumber company, to be placed in a new large saw mill with planing mill, sash and door factory annexed. It drives the complete plant, and is said to give nearly 600 horse power, under only 16 feet head. The same lumber company have had in operation for a number of years, eight or ten wheels of the same make.

The illustration shows the wheel in its casing, with a pair of surmounted gears, and the supporting bridge word. In this condition, it was entirely too large for shipment, of course, and was dismounted, and loaded upon three separate cars. The entire weight of portion shown, is upwards of 45 tons, the largest diameter being 15 feet, and the height to the top of the gearing about 22 feet. To the opening or mouth, shown in the illustration, a pipe of some 50 feet in length, and 10 feet in diameter was connected.



A MAMMOTH WATER WHEEL.

The illustration indicates the great capacity of James Leffel & Co.'s works, and their ability to turn out water power plants of great magnitude. The wheel is fully up to the standard that has won for the James Leffel & Co. so enevitable a reputation among water power users.

RICH copper veins have been discovered on the island of Madagascar.

INTERESTING QUESTIONS FOR STEAM USERS.

Waste of steam and power, and consequently of money, is going on to a greater or less extent in all manufacturing establishments. Much of this might be saved, were it known to exist, but in by far the larger number of cases the steam user is blissfully unconscious of the steady drain that is being made upon his pocket, and fondly imagines that his coal bills are fully warranted by the amount and character of the work which he is doing. If his steam plant is satisfactory in point of appearance, he is often quite content, and will not trouble himself about possible defects which a little investigation would readily expose and the removal of which might make an important difference in the year's balance-sheet.

The question propounded at one of the recent topical evenings of the American Society of Mechanical Engineers—"Have you any idea what your power costs you?"—alone suggests that there are a large number of power users who do not know and who have never taken the trouble to find out, and it is to them that a series of questions, recently issued in circular form by a New York consulting mechanical engineer, ought to be of considerable interest. The questions reads as follows:

Do you know how much it costs you for steam used in your engine, and, consequently, for your power?

Do you know that there may be very large and preventable wastes which may represent a goodly sum of money to you every month?

Do you know that the valves may be out of adjustment and the pipe arrangement faulty, entailing serious and needless expenditure of money on your part?

Do you know that an engine may be running smoothly and apparently very satisfactorily, and yet be very wasteful, because of some hidden and unknown defect?

Do you know that to secure and maintain the best conditions for economy, an engine should be periodically tested by the indicator, and that the indicator will reveal any hidden defects?

Do you know that the cost of an intelligently conducted indicator test is an insignificantly small percentage of what it might enable you to save?

If you are selling part of the power from your engine to some one else, do you know exactly how much, and whether, therefore you are getting a proper money return for the power which you are supplying?

To these questions is appended the statement, "if you do not know, it would pay you to find out." There is little question that if the trouble of this were generally appreciated, as it should be, an important saving of money would be effected in many establishments—a saving which would much more than counterbalances the expense of locating the money leaks in the operating departments, and which would conclusively demonstrate that the services of a consulting engineer are not needless luxuries, as is often imagined, to be indulged in only by an extravagant few.

There are plenty of practical examples to show the truth of this. We have in mind the case of an incandescent electric light plant in a mill, driven by a 12"x12" horizontal engine. A large condensing engine furnished power for the mill machinery, and the steam pressure carried by the boilers was only 30 pounds. This was insufficient to produce the required power from the small engine, and the latter was therefore connected with the condenser to obtain the advantage of 26" of vacuum. Even when thus connected, however, the engine proved unequal to the work and the electric lamps could not be brought up to their normal brilliancy. After much dissatisfaction it was concluded to put in a larger engine, but, as a last resort, before taking this step, the services of an expert were secured to determine, if possible, whether this rather costly proceeding was really necessary, and whether, with some changes in arrangement, the engine then in place could not after all be made to perform satisfactorily.

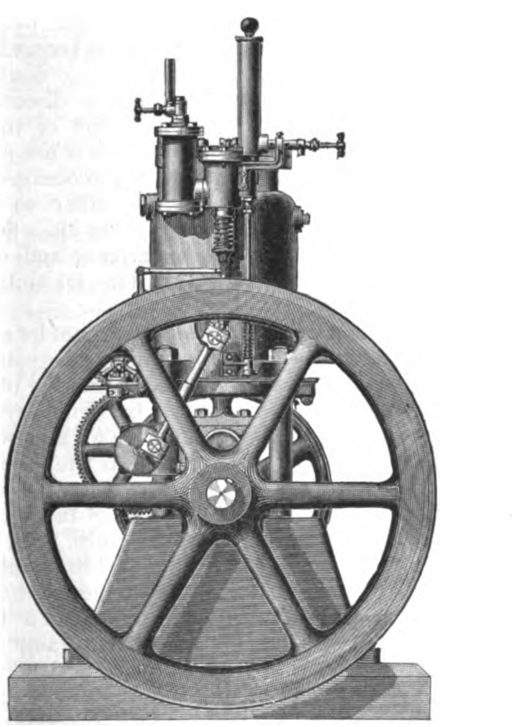
The indicator being applied to the engine, it was found, strangely, that no vacuum whatever was obtained, the back pressure line of the diagram coinciding practically with the atmospheric line. A little further examination quickly showed the reason for this. The exhaust pipe led rom the engine downward, then to the left, then upward, and then, after another turn to the condenser, making in all four turns. Besides, the owest section of the pipe formed a reservoir for any water discharged from he engine cylinder, and the exhaust steam had to work its way through his "water-leg." All this together completely neutralized the vacuum in he condenser.

The exhaust pipe was disconnected and re-arranged, doing away with he "water-leg" and two turns. After this had been done, a fair vacuum was obtained in the engine, and the lights gave entire satisfaction. The expert's bill was about $50, as against a contemplated outlay of about $1,000 for a new engine, not counting the loss of time which the erection of such a new engine would have entailed. Need it be said that the expert's fee occasioned no murmur?

Another case that we know of involved the question of the amount of power furnished to a tenant. A contract had been made several years previous with the owner of the power plant to have him supply about 30 horse-power for the operation of some shoe machinery. The amount of power was roughly estimated from the size of the transmitting belt and pulley, and everything proved eventually satisfactory for a time. Gradually, however, the tenant's machinery was added to, and his consumption of power increased correspondingly, until finally, the other party to the contract suggested the propriety of an increased payment for power supplied. What was at first a good-natured discussion of the proper basis for the increased charge threatened to end in a rupture of friendly and business relations, but in the end it was agreed to call in a consulting engineer and to abide by his decision as to the amount of power actually furnished. An indicator test quickly decided the question. The expense of the test and report was $35, and both owner and tenant were satisfied with the result. It added about $1,500 to the annual revenue of the former, and reestablished pleasant business relations all around. In both cases the expert fee was almost nominal considering the interests involved, and the ncurrence of the expense was in each instance a good investment.—[Mechanical News.

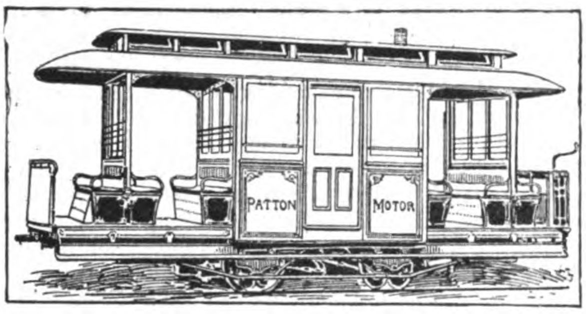
PROPELLING STREET CARS BY GAS ENGINES.

One of the illustrations in this article calls attention to the vertical engine made by the Van Duzen Gas Engine Co., to use with gasoline as fuel, but it can be used with gas. This style is used on either portable or traction engine and usually for marine purposes. The cylinder is cast in one piece, preventing any possibility of leaking between joints by the unequal expansion and contraction of the two, the same as in their horizontal engines, and is supported by four steel standards, accurately turned and finished, and of sufficient strength to sustain any strain liable to be put on them. They are securely fastened in the base and support the journals, gear-wheel shaft which operates the valves and governor. The base and pillar blocks are cast in one piece. The crank-shaft, governor valves, connecting rod and balance wheels are the same as used in the horizontal engine, and are found by experience to give satisfaction.



As inventive genius is seeking to find some way to obtain needed motive power to run street railway cars at a comparatively small expense, and do away with all the annoyances of poles and overhead wires, this article calls attention to a system of motive power which solves this problem, and when more fully and better known will be more extensively used, as orders on hand plainly indicate.

A new use has been found for this vertical engine by the Patton Motor Manufacturing Co., whose plant is in Pullman, Ill., and whose office is at 44 Lakeside Building, Chicago, Ill. Mr. A. B. Pullman, of the Pullman Palace Car Co., is President; H. H. Latham Vice-president; H. G. Bird, Treasurer; W. H. Dyrenforth, Secretary; Thos. Saunders, General Manager. This company manufactures the Patton motor, a new method of propulsion for street and elevated railways. In the use of this motor, wires, poles and power plants are entirely done away with and the parts to be used, which act simply and in perfect harmony, are a gasoline engine, accumulator, dynamo and motor. The expense of this motive power, as found by actual experience, is 17 to 20 cents per hour. In the use of this engine and dynamo there is a continuous service and constant generating of electric force received by the accumulators and all surplus not required for use is stored for any emergency. The accumulators are never fully discharged and thus any perceptible wearing of the plates is obviated. The arrangement of this machinery is very simple and easily handled by any one of ordinary ability. They carry 100 accumulator cells of sufficient strength to develop 80 horse-power, if needed. The gasoline engine is put in position on the trucks, independent of the car body, and geared direct to the dynamo by friction, and being controlled automatically requires no attention. The electric motor being geared direct to the axle received its energy from the dynamo current supplemented by the reserve power when needed, from the accumulators. This additional current is governed automatically. In the working of this motor power on the grade or level track carrying a light load, or when car is not in motion, a constant generating power exists, producing a surplus electric force. In most systems this would be a dead loss of power, but in the Patton motor system these accumulators are so arranged as to take care of this surplus force, which would otherwise be wasted. The engine and dynamos use a space six feet square and are entirely housed, the accumulators conveniently stored and the machinery of the car is from public view. It is operated by one man, stationed on either platform and any desired speed is obtained. It can be managed as an independent car to draw trailers or as a combination for carrying passengers.



The Patton Motor Manufacturing Co. have been using this motor on the street railway in Pullman for several months, and in so doing have had in use two of the Van Duzen vertical engines, one 20 and one 30 horse-power, which have given complete satisfaction. Severe tests show it to be a practical motive power, as they have since ordered more to meet the demand which is constantly increasing. The illustration gives a good idea of a combination passenger street railway car, in which the motive power is used as stated. This car is arranged to carry 30 passengers.

The Van Duzen Gas & Gasoline Engine Co., No. 25 Broadway, Cincinnati, or the Patton Motor Manufacturing Co., will give any additional information to any one desiring to make further inquiry.

ELECTRICITY VS. STEAM.

The inadequacy of all electric locomotives proposed for heavy and frequent passenger trains—for service such as must be handled on the prominent suburban railroads—has several times been referred to in these columns. We have pointed out what seems to be a lack of appreciation on the part of the electric companies and designers of the problem to be solved. We now present some definite information on this subject, to show clearly what is needed in an electric motor if it is to do the work now performed by steam locomotives in the service referred to. The data are based on the present operation of the suburban section of the Illinois Central road in Chicago, one of the largest suburban traffic fields in this country.

The lengths of the stops average about 15 seconds when the trains are not too crowded and the trainmen are alert. The trains are composed of from four to 16 cars, according to the traffic, and the average number of cars per train is six.

The data are based on actual speed and indicator-diagrams taken from the suburban engines on the road, and are as accurate as necessary to give a perfectly safe basis for estimating the power needed to run the road by electricity. From diagrams we have calculated the average and maximum horse-power between stations required to pull a train, and the average and maximum horse-power required to run all the trains. The results are given in what follows, together with the amount of coal consumed per useful horse-power absorbed in hauling the cars and their lading per hour:

Average number of cars per train	6
Maximum number of trains on line at any one time	14
Maximum number of cars on line at any one time	84

Average horse-power required between stations to overcome the inertia and the friction of the trains, as shown from the acceleration diagrams	390
Maximum horse-power required between stations to overcome the inertia and the friction of the trains, as shown from the acceleration diagrams	510
Average pull on the forward drawbar of the train in pounds, taken as an average of the pull between stations	7,750
Maximum pull on drawbar at starting, pounds	14,000

If all the trains are running exactly according to the large diagram, which accords with the time table, then the following averages and maximums may be deduced:

Average aggregate horse-power for all trains on the line	2,600
Maximum horse-power for all trains	4,500
Aggregate pull on forward drawbars, average pounds	51,700
Aggregate pull on forward drawbars, maximum pounds	108,750

If it happens that all trains are running at once, but not necessarily all starting at once, then the following is obtained:

Average horse-power for all trains	6,270
Maximum horse power for all trains	7,140
Average pull for all forward drawbars, pounds	172,200
Maximum pull for all forward drawbars, pounds	196,000

The following are the averages between the hours of 5 and 6:20 P. M.:

Average number of trains on line	12 3
Average number of trains accelerating at one time	6.6
Maximum number of trains accelerating at one time	10.0
Average number of horse-power hours of work done by each steam locomotive per day	2,145
Average amount of coal used by a steam locomotive in doing 2,145 hours of work, pounds	14,000
Average amount of Illinois coal used per horse-power hour, pounds	6 52

The diagrams and tables give exactly what an electric locomotive will have to do in order to duplicate the work now done by steam locomotives. This is outside of all problems of switching, signaling and distribution of power. Of course, all those matters are readily settled. Where a railroad company owns its right of way, it is comparatively a simple matter to lay conductors for the electric current, and the switching of the current can be readily done. The whole question about the substitution of electricity for steam is centered around the possibility of getting a motor sufficiently powerful to do the work, and the handling of such powerful currents as would be necessary on a line like the Illinois Central, where a total of 7,000 or 8,000 horse-power is needed. The business of the Illinois Central is constantly growing. The number of trains will be doubled within the next few years, and the suburban business will be extended further from the terminus. But, of course, more than one electric station could be used to supply the line, and distribution, in itself, is probably not an insurmountable obstacle. The problem that remains to be settled before much enthusiasm can be aroused among steam railroad men is that relating to the possibility of making an electric motor with power equal to that of the steam locomotive. It will be noticed that the average horse-power between stations is about 390, while the maximum is 510.

The problem then is to construct and maintain an electric locomotive of sufficient weight to haul a train, one capable of evolving from 500 to 800 horse-power. More than one motor to a train is practically out of the question. The exigencies of excursion days, when heavier and more numerous trains are run, we will ignore for the present. It now remains for those engineers who make electricity a special study to bring forward their plans and show what they propose to do. As yet they have shown no evidence of ability to meet the serious problem we have here outlined. Many railroad men have a feeling of confidence that electric motors will some day supplant our steam locomotives, but it is in most cases decidedly indefinite, not to say superficial. This sentiment encourages the electrical inventors, and it is right that it should, but they will need something more tangible if they are to make the desired progress.—[Abstract from the Railroad Gazette.

HINTS TO ENGINEERS.—XI.

BY EDWIN WOODWARD.

While a knock in an engine is always the outgrowth of a loose joint somewhere, it is very sensibly augmented by an improperly set valve, or a counterbalance of faulty design as to weight or position in which it is placed. But the valve gear being deranged is a most fruitful disorder—many disastrous results follow—the engine labors and strains at every revolution, nearly devoid of effective power; because, perhaps, steam is admitted late and, of course, necessarily cut off late—the exhaust does not open perhaps till the piston has started on its return stroke—the imprisoned steam gathering force by the compression till the valve lifts to let it escape, then other unused steam goes with it nor stops till the valve moves forward far enough to give it vent, when the pressure becomes somewhat greater in the steam chest than the cylinder.

But the eccentric slipping is not the only evil that befalls this important part, for the valve will get wonderfully out of place when the crank and eccentric are cast one, or the eccentric keyed to place. In this case the valve rod usually gets short by wear and adjusting, and so may have lead at one end of the stroke—and to spare—and at the other end none. This leads to the important matter of adjusting the length of the rod—the first step in setting the valve. The learner is frequently instructed to "Place the engine on the dead center, then turn the eccentric forward in the direction it is to run till it has sufficient lead; then place the engine on the other center and discover if the valve has the same lead, if not, the rod should be lengthened or shortened as required, till both ends are alike." The plan of teaching and indelibly fixing a lesson on the mind by exposing bad methods and contrasting them with good, is commendable. But what may be said of it when only the defective way is explained? It is very evident after the slightest consideration, that if the length of the rod is corrected after the valve is set, the set of the valve is thereby affected, and after each alteration of the rod the valve must be re-set, and consequently it is much more logical to correct the length of the rod as a first step. In the plain slide valve, the travel should be sufficient to open the port its full width, and the length of the rod should be such as will necessarily make the valve travel equally beyond the admission edge of each port. This would be theoretically correct, but practically it is not, and will be further alluded to.

The readiest way to correct the rod is to turn the engine and measure the distance the valve travels beyond the edge of the port. But if the engine be large, this method is impractical, and the same result is obtained by loosening and revolving the eccentric on the shaft. The proper length being determined, the next point is to find the dead center. This is often found by level—if the connection or at least the strap ends are level the engine is said to be on the dead center. This method does not find favor with the writer—most engines are not level and the level then to be available must be adjusted to suit the incline. A much better method is by means of trams.

The method is best illustrated by a diagram, Fig. 9. The engine should be turned over to near the center, about nine-tenths of the piston stroke. Make a prick mark with the center punch on the fly-wheel at A, and at A' a mark on some fixed part to coincide with it, and then with the tram mark the relative position of the crosshead at C, with the guide bar at D. Then turn the wheel in the direction of the arrow over and beyond the center till the tram fits the marks C and D, as before, when the fly wheel will have traveled the distance from A to B. B now being at A' its place should now be marked with the prick punch. With the dividers locate the midway point between A and B at E, and that being turned at A' the engine is on the center. The opposite center is found in the same manner, working from the other end of the stroke.

The center being found, the setting of the valve is easily accomplished. It depends much on the design of the engines, the valves, valve travel, ports lap, clearance, etc., whether the valve should be given lead or not. The object of lead is to stop the momentum of the reciprocating parts of engine, and is accomplished by admitting steam before the piston has reached the end of its stroke and the fact that it accomplishes its object is the one point in its favor. That such use of steam is extravagant, is generally conceded, for by closing the exhaust before the piston reaches the end of the stroke, arresting the forward advance of the piston by compressing the steam remaining in the cylinder, the same effect is secured without levying on the boiler, and the same steam is thus made to do double duty. If the valve is to be given lead, turn the eccentric in the direction the engine is to run, till the valve has uncovered such a portion of the port as may be deemed necessary to accomplish it best. This is not always secured on the first trial, and the learners should not be discouraged if three or four efforts do not show the best results. Engines differ so in construction and design that no general rule can cover them all. So many elements enter into the problem that it is only by experience and constant study of the cause and its effect that a first-rate reputation for ability in this line is achieved.

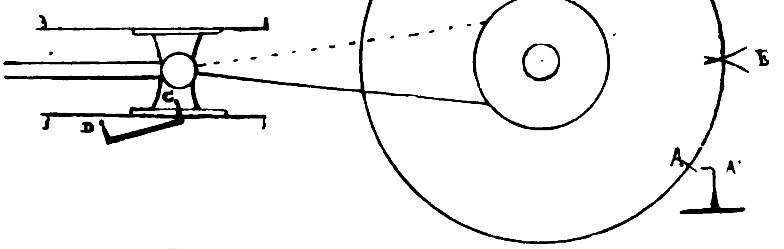
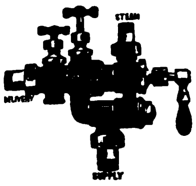


Fig 9

It is not uncommon to find engineers that cannot be excelled for keeping certain types of engines in good running order—any disorder is as quickly located as his tooth-ache—but put him in charge of some other style of engine, in a dilapidated condition and require him to evolve order out of the chaos—chaos is most likely to reign supreme for a season till the engine and its peculiarities grow into his nature, and inasmuuh as this condition arises mainly from solving the same problem repeatedly (or at best only put to him in another way), it is the cherished desire of the wide awake student to have to do with many styles and various difficulties. But the desire should not be so dominant as to lead him to "tramping" to widen his knowledge. The knowledge so gained is not of value to the engineer, as a rule, besides the restless habit so induced grows with time, till it masters the man, and eventually, from tramping to learn, it becomes tramping from custom, and as this trait increases, the desire for knowledge decreases, till nothing is left but a tramp, and a pauper, and a thoroughly dissolute and worthless scamp, and it is a disgrace to an honorable profession to say that he ever was an engineer. But as before intimated, experience is not all that is required. Peculiarities of construction are easily forgotten, but the effects of a certain cause, when once grasped are thereafter ever at command, and should be carefully considered and whatever is required for the clearance, be it lead if the valve does not give sufficient compression, or compression if that is abundant, the reason of its use should be clearly understood. Then if aught comes amiss, remedy is ever at hand.

THE GARFIELD AUTOMATIC INJECTOR.

There are many injectors on the market, and it is a dull day indeed that does not bring forth a new one. Probably there are more firms and individuals making and preparing to make injectors than any other article used about a steam plant. Of course, the demand for them is large, but only a small percentage of the new ones ever amount to anything, leaving a few in possession of the field. There are some of these machines that have stood the test of thorough trial for a number of years. Among them is the Garfield. The makers of this injector spent a great deal of money and time perfecting, and to-day they are, among the manufacturers of injectors only, rated second by the commercial agencies for capital invested and general substantiability. Their machine has a very wide sale, and in buying one the purchaser gets the guarantee of proved efficiency and financial solidity.



A cut of one of these machines is shown herewith. The manufacturers desire to procure responsible agents in parts of the country not now covered. Any one having to do with selling, erecting or repairing machinery and steam engines and boilers would do well to correspond with them at once. The makers are The Garfield Injector Co., Wadsworth, O. Descriptive circulars and prices will be sent to any address.

New Catalogues.

The Herendeen Manufacturing Co., of Geneva, N. Y., has issued a new catalogue, accompanied by a pamphlet on "Home Warming and Ventilation."

The Joseph Dixon Crucible Co., of Jersey City, N. J., has published a new catalogue devoted to their graphite productions. They know how to make a volume of this kind very interesting, and the new work is no exception to the general rule.

The Lunkenheimer Brass Manufacturing Co., of Cincinnati, O., have recently published a new catalogue, very artistic in style, showing the latest makes of and giving the latest information concerning their large line of brass goods.

The Jones & Lamson Machine Co., box 26, Springfield, Vt., have just issued the third edition of their "Rapid Lathe Work by a New Method." It relates to the operation of the flat turret lathe, the invention of Mr. James Hartness, manufactured and sold by them. The sale of this lathe has been very large. The new edition of "Rapid Lathe Work" is a marvel of art.

Any one wanting mill machinery or power would do well to write to D. K. Norton & Son, of Cincinnati, O., for their last catalogue of mill supplies and engines and boilers. It contains almost every kind of manufactures in that line, and from the many cuts and descriptions of the uses of the machinery, much information can be had. They give particulars of the large line of second-hand engines and boilers, and any one seeking a bargain will be likely to find it in this catalogue.

Trade Notes.

W. F. & John Barnes Co., makers of lathes, drills, and other machine tools, Rockford, Ill., report business brisk, and no cessation of orders. They are among the oldest manufacturers of machine tools in the country, and were the pioneers in the West.

The Long & Allstatter Co., of Hamilton, O., continue to make large numbers of their efficient punches and shears—double, single, horizontal, multiple, automatic spacing, etc. Their catalogue will be a source of much information for any one interested in these tools. It is, of course, sent free on application to those thinking of purchasing.

The man who sells goods to his shopmates makes a mistake if he does not handle the Stevens patent machinists tools, made by the J. Stevens Arms & Tool Co., box 216, Chicopee Falls, Mass. Catalogues sent on application.

The Armstrong Bros Tool Co., 78 Edgewood avenue, Chicago, report a very active trade on their patent tool holder. The tool is a very handy one, better and cheaper than any that can be made in the shop. A circular describing it is sent free on application.

The Oldest Publisher of Mechanical Books.

It may be interesting to know that the oldest scientific and mechanical publishing house was founded in 1785, by Mathew Carey, at Philadelphia, Pa. It has grown slowly and steadily ever since, and is now the largest as well as the oldest. The management has always been singularly upright and able. It is now Henry Carey Baird & Co.

Any one who wishes any book whatever on the sciences or industries, should remember that this house publishes the most complete list in the world. They say in all their publications and advertisements: "Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other catalogues and circulars, the whole covering every branch of Science, applied to the Arts, sent free of postage to anyone in any part of the world who will furnish his address."

The firm of Henry Carey Baird & Co. is located at 810 Walnut street, Philadelphia, Pa.

A Gigantic White Oak Tree.

The largest piece of white oak, probably, that was ever sawed to order and shipped to New York, says the *Recorder*, was 30″ square and 50 feet long, and measured 3,750 feet, board measure. It weighed 22,500 pounds, railroad standard weight for green oak timber. The tree measured over 3½ feet in diameter 50 feet from the ground. Another piece was also received at the same time which was 24x20″ and 60 feet long. The two pieces made 6,150 feet and were all that was shipped in two cars which came from Ohio.

Extension of Cleveland's Machinery Supply Depot.

The Parkin & Bosworth Co., dealers in all kinds of machinery and supplies, Cleveland, O., have now a new and spacious store on the Viaduct which is connected with the old store on So. Water street. They have recently put in a very fine new line of tools, light, medium and heavy, and at prices to suit the notion of every buyer. This company started in Cleveland some nine years ago, and have made a wonderful success in the machinery trade. They are known as a very square dealing firm, which sells none but first-class goods. Their new number on the Viaduct is 76.

Powerful Indian Air Guns.

The Indians along the Mirida river hunt with blow guns made out of the young stalks of a certain kind of palm, from which the pith is removed. The arrows employed as projectiles are simply splinters of reed, sharpened at one end, the other end being wrapped with enough silk cotton obtained from another kind of palm to fill up the bore of the blow gun. The arrows are about 10″ long and very light. They are tipped with the famous and deadly "woorari" poison.

Used by one of these naked savages the blow gun is a weapon of great accuracy and effectiveness, even a small bird on a treetop being brought down by the skilled shooter with reasonable certainty at the first try.—[Interview in Washington Star.

Thirty-Eight Years an Engineer.

Who in Western New York on the Niagara Falls branch of the Central has not seen, or ridden behind, "Old Browser," who runs the morning accommodation out of the Falls, reaching Rochester when the finger of time is nearly on the point of 10, and returning as the shadows are pointing toward 5? Truly he is a graybeard, and from October, 1853, has looked out of his keen eyes along the shining rail to see that all was right ahead, for he has carried in over 38 years nearly 5,000,000 of human beings, and has not killed one passenger. In drawing this vast number of accidentable persons he has wheeled the circuit of this globe over 66 times, nearly 2,000,000 miles. Where in this or any other country is an engineer who has a living record of this character?—[Rochester Union, June 28.

Of Interest to Machine Shops.

When seeking prices on machinery it would be well to address Mr. W. P. Davis, of Rochester, N. Y., and ask for his catalogue. Mr. Davis makes a most excellent line of key-seating and cutting-off machines, and has besides a large store in which he carries machine tools of every description, new and second hand. His catalogue contains a list, carefully revised every few weeks, of second-hand lathes, planers, drill presses, and other tools at very low prices. Address, W. P. Davis, Rochester, N. Y.

An Important Surgical Tool.

The latest electrical surgical instrument consists of a hard rubber tube, inclosing a number of small wires, which is designed to be attached to the tip of the finger. It is for use in internal operations, and is intended to transmit substantially the same sensations to the operator's finger tip that he would experience if his finger were actually present where the device is and in contact with the same surface.—[Prescription.

THE Cleveland Division of N. A. S. E., No. 5, of Ohio, extend to their friends and the public in general an invitation to attend their annual excursion and picnic to Cedar Point, Sunday, July 31, '92. Train leaves Union depot at 8:30 Standard time, stops at Detroit street, Berea and Elyria. Tickets $1; children 50 cents.

THE diameter of a lightning flash can be measured wherever a bolt of lightning has entered a bed of sand. It turns the silica of the sand into glass and makes a glass tube in the earth which is called a "fulgurite." These have been followed into the sand for 30 feet. They vary in diameter from the size of a quill to 3″.

THE Union Iron & Steel Co. is the name of a new concern formed by the consolidation of the interests of Cartwright, McCurdy & Co., of Youngstown, and the Youngstown Iron & Steel Co. owning the Youngstown, Girard and Warren rolling mills in the Mahoning Valley.

WATCH crystals are made by blowing a sphere of glass about one yard in diameter, after which the discs are cut from it by means of a pair of compasses having a diamond at the extremity of one leg.

FOR iron rust lay in kerosene oil and let it remain covered for some time. The oil will loosen the rust so that it will come off.

Burlington Route New Service.

A through Pullman sleeping car Chicago to San Francisco is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11.45 A. M., less than four days en route.

STEAM BOILER EXPLOSIONS.

BY THOMAS MASON.

The apprehension of the public is aroused by the recent frequent occurrence of accidents, in some of which there has been serious loss of life. One of the best ways of allaying this apprehension is by investigation, which a committee recently appointed by this association, with that end in view, has concluded that there is no doubt that these accidents were not unavoidably incident to the useful agent, steam, but resulted from a want of due regulation of its power, or from other circumstances incidental to its use, which could have been foreseen and by proper regulation guarded against.

The difficulty of obtaining satisfactory evidence as to the cause of these disasters is well known. Quite frequently those to whose mismanagement or lack of care they were due have been among the victims, and even when they have survived, the precise state of things immediately preceding the occurrence, has either been unknown to them or their testimony has been biased on account of the position they occupied—hence mystery, and the public has to be satisfied with the number killed and amount of property destroyed, added to a few suppositions of no material value, and exposure to like future danger.

Explosions may be classed under four heads:

Undue pressure in a boiler.

Unduly heated metal in a boiler.

Defects in constructing a boiler or its appendages.

Carelessness or ignorance of those in charge.

A mere reference to these is all that is possible in a paper of this kind, but any of the four subjects can be studied with profit.

EXPLOSIONS FROM UNDUE PRESSURE.

The idea that a boiler will not explode if duly supplied with water has been proved untenable, and is mischievous in its tendencies. Undue pressure from within, either sudden or gradual, can produce the most violent of explosions and is, no doubt, as often the cause of them as any other. I have known engineers of recognized ability to contend that as long as a boiler is kept closed, disaster from this source would not follow; but, if an opening occurred, either by the safety valve being pulled up or the stop valve opened, the boiler would go up, but not otherwise.

That is all right, and either of those actions would be wrong if the pressure got much beyond that allowed, but I do contend that a pressure can be attained, and often is attained, (whose effects with a working engine will be felt quicker than when not working) that will tear a boiler to pieces. We have no more reason to doubt that a boiler can be torn apart by such a strain, than we have to doubt that a tensile strength of 54,000 pounds will tear an inch of iron apart.

The boiler of the tow boat "Parker," which blew up at Bridgeport, several months ago, is a possible example of this kind. She had a heavy tow which became grounded. The statement of the only survivor of the crew (there were eight or nine killed, some of whom were spectators watching her from the dock) was that, "there seemed to be the usual amount of water in the boiler but she was laboring hard and steaming for all she was worth."

The shell gave out near the water line, tore downward and blew the bottom out of the boat, the upper part of the shell flying in pieces and killing some of the people on shore. The exact condition of things previously can never be known; some thought it possible that the boat careening, laid part of the tubes bare and the water returning to them caused a rupture, but to combat this idea, the tubes were found intact. This fact, added to the evidence mentioned, made undue pressure a not unlikely cause of the disaster. To guard against this trouble, every boiler should have two safety valves, one the ball and lever type in control of the engineer or fireman, and also a first class pop-safety, properly set; both these valves should be frequently handled, so they will not become corroded and the steam gauge should be occasionally tested for accuracy, especially where but one boiler is in use and the opportunity for comparison with other gauges is not available.

EXPLOSIONS FROM UNDULY HEATED METAL.

We know that no part of a boiler exposed to fire, but should be in immediate contact with water, the temperature of the iron cannot then exceed that of the water; when from any cause it becomes unduly heated it is weakened and may give out at some future time, even under ordinary pressure, and, again, it becomes a reservoir of heat, which if water touches it, produces steam of so highly elastic a nature that explosion is likely to occur.

During experiments conducted by the Franklin Institute, of Pennsylvania, it was found that drops of water vaporized most rapidly at a temperature of 334° under atmospheric pressure only; the development of a repulsive force was so rapid above this temperature that drops which, at the temperature stated, disappeared in two seconds required 152 seconds when the temperature was raised to 395°, and here we have a clue to the action of water on heated metal. When the quantity was increased 16 times and put under pressure the most rapid vaporization occured at 600°. So you see this highly elastic steam was produced most rapidly under pressure and, in one case, when the water was separated from the bottom of boiler, until it was heated red and then suddenly inflected on it, the steam pressure increased 180 pounds in three minutes, the boiler then exploding.

The time required for the generation of this explosive steam cannot be calculated, but we know that it is more rapid than can be taken care of by a safety valve and shows the risk taken when an attempt is made to put water into a boiler when unduly heated metal is liable to be exposed to it.

The Warren Springer explosion at Chicago is undoubtedly an example of this kind, but the able article of Mr. A. F. Nagle in the March number of *Power* concerning this disaster makes further reference to it unnecessary.

Lifting or foaming is a source of danger and was no doubt the cause of the explosion at the Canal Pumping Works, Chicago, a year ago. The water supply was taken from the river, which is virtually the city sewer, and at certain seasons is quite impure. In cases of this kind the engine should be slowed down or stopped, as the case required, and if the foaming continued when the engine was started again, more boiler capacity should be added; or if this was not available the supply must come from a pure source—the usual surface or bottom blowing is not a permanent relief with impure water of this nature.

As a guard against low water the use of fusible plugs is not always satisfactory; the alloy used is tin, lead and bismuth. For 60 pounds pressure the proportion should be eight parts of tin, eight of lead and three and a half of bismuth. As the pressure increases, the quantity of bismuth is gradually decreased, until at 150 pounds pressure we need none at all. The temperature of steam at that pressure being near enough to the melting point of tin an alloy of lead and tin is sufficient. Unless care is taken in the mixture of this metal to suit the different pressures for which they are intended they are worse than useless, for they blow out and cause unnecessary alarm.

Concerning the construction of boilers it is not possible to consider the numerous varieties of form at present in use, but when high pressures are employed we should avoid flat surfaces as much as possible and keep to the cylindrical form. A sphere will resist twice the pressure of a tube of equal diameter and a tube nearly twice that of a square surface. Why is it that a boiler always gives out at the longitudinal seams? Suppose we set off two points, A A, on the circular head of a boiler [Illustrated on blackboard] and two straight lines, C D, and C D on the longitudinal shell of a boiler of equal distances apart, the two triangles, O and O, have but one-half the area of the parallelogram C D D C, and consequently can receive but one-half the strain; hence the shell goes first. All pressures are exerted in the line of the greatest diameter, and while the tubes are an element of strength to the heads of a boiler a hollow shell would certainly give way first in the line of the longitudinal seams.

The inspection laws of Chicago provides for the bracing of ordinary flat surfaces, as follows: Using 140 as a constant multiply, this by the square of the thickness of plate in 16ths of an inch and divide this product by the square of the distance of stay bolts from center to center; this will give the working pressure allowed. [Examples given.]

When flat surfaces occur in marine boilers in back connections or fire boxes, the same rule is enforced, only the constant used is in this case is 112 and the bolts are not allowed to be more than 11" apart. Allowing in each case 5,000 pounds tensile strain for each square inch area of stay bolt in the appendages to a boiler, there should always be more than one valve between the pump and boiler, both on steam pipe and delivery, so in case of accident steam could be shut off without danger; feed pipes should also have at their lower end, near the boiler, a pet cock so that any generation of steam in pipes can be blown off; this charging of feed pipes with steam is often a cause of anxiety and the remedy should in no case be neglected.

Familiarity with any sort of danger is so sure to produce calousness to it that an engineer is often careless. This subject of the causes of explosions has been so little investigated that men well versed in general science might be excused for ignorance of it, and steam engineers should not be hastily blamed for what is incident to the very nature of their calling, rather than a fault. The fact of carelessness or ignorance has, however, been so much insisted upon by the outside world that it must almost be assumed and an effort made to supply a remedy.

It is not right to expect that firemen or many engineers should be versed in the scientific principles which regulate the use of steam. The public have, however, the right to expect from employers that those who are entrusted with human life should have a thorough, practical acquaintance with the steam engine and boiler, and also to demand that those who have information of the sources of danger should lay down plain rules for the guidance of those under them and as a guard against carelessness; the public have further the right to exact from the municipal government the law that those having charge of engines or boilers should, by strict examination as to their qualifications as engineers, be found worthy to be entrusted with their care.

[The preceding was read before the Robert Fulton Association, N. A. S. E., of Chicago, June 5th.]

ELECTRIC POWER STATIONS.

BY HORATIO A. FOSTER.

Although it is the province or this Institute to consider largely the more theoretical side of electrical engineering, and rightly so, it is perhaps well that it should occasionally have brought to its attention that outside practical part, only for which theory would have no backing, and therefore could not reach its proper development.

It has been the fortune of the writer during the last ten months to visit and inspect, both technically and financially, considerably more than a hundred central lighting stations.

* * * * *

Perhaps if instances be mentioned under the following heads a better understanding can be arrived at, viz.: Location; foundations; construction of station; motive power; arrangement of machinery and location and construction of lines.

LOCATION.

The location of plants is not now so generally bad as in the past, although we occasionally find a station in a location for which no excuse is apparent, as, for instance, one located in the basement of a carpenter shop at a long distance from fuel supplies, and only plenty of condensing water to recommend it; insurance rate 3 per cent. or more. Another location nine miles away from a village of two thousand people to take advantage of water power never surely available all the year, and since destroyed entirely for the greater part of the year. Another placed so low down in reference to its water power as to be flooded in freshets. Another located more than a mile from fuel supplies and the center of distribution, at the top of a long, steep hill, with not even free water to recommend it. Another so located in relation to a very intermittent water power as to be unable to take advantage of the water for condensing purposes and now running the poorest kind of a slide valve engine. Another located in a rickety, old, uncared-for part of a gas house where coke is scarce, and apparently plenty of water power available within half a mile.

Another located a long distance from center of distribution and coal supplies, to take advantage of cheap land and cheap fuel, the last of which has since proved very unreliable, when seemingly land could have been had much more central, with a much surer supply of cheap fuel, and, to cap all, the value of that land has since increased enough to have paid the entire cost of the station at any moment it be desirable to sell.

One advantage of some of the older centrally located stations has since been learned in the increase in value of such real estate. One such station visited will enlarge and rebuild soon, and will sell its present real estate for enough advance to go far toward paying for the new station, and there are others which can, I think, tell the same story. In fact, in the present problematical growth of the future; a well-selected piece of ground may prove a very valuable part of the investment.

FOUNDATIONS.

Foundations are not much better than in the past, and some of those now placed under dynamos would sustain almost anything that could be put on them. Poor foundations are occasionally seen though, as for instance those under a large bank of boilers in a station which was erected and started in six weeks. The boilers have since lurched forward until the fronts are some two or three inches out of plumb. In fact, too little attention seems to have been paid to boiler foundations as a general thing.

Engines have fared better, and when the ground has been good the foundations are to be little criticized.

One station has very large Corliss engines, and owing to water-soaked ground and limited time in which to build the brick foundations, they were placed wholly above the floor level of the dynamo room, and belts run both ways from the fly-wheels to shafting on either side of the room.

Very few bad dynamo foundations are now met, but many unbalanced armatures are found which no amount of foundation would hold steady.

STATION CONSTRUCTION.

In station construction there has been no settled design, therefore the promotors have generally built as they saw fit, occasionally following suggestions of the agent. Of course many plants are located in buildings already up, in which case the machinery had to be made to fit.

In many of these built especially for the work, no attention has been paid to designing for a low insurance rate, and brick stations are found sheathed all over the inside with pine; the one thing that insurance inspectors always criticize. A couple of coatings of whitewash or paint would have been much cheaper, safer, and looked quite as well.

When stations have been remodeled very little improvement has been made in the smaller ones, but those in large cities have generally taken advantage of all the improvements to date, if not too strongly attached to some one parent company.

MOTIVE POWER.

The selection of motive power has of course been governed by local conditions; in the Northern and Northwestern parts of New York State water power is abundant and is largely used as motive power for stations, but almost invariably with steam reserve.

Water power alone has been found very difficult to govern for uniform speed, and some of the devices used for that purpose are, to say the least, ingenious.

When the load is large enough to use part steam there is no trouble whatever, as the wheel takes a steady load and the engine does the governing.

Plants are sometimes placed a long way from the work in order to take advantage of water power, and in some cases it seems as if all else had been sacrificed to that one point.

Of engines there is no end to the different design, style and size used. Some use high speed, belted direct to dynamos, others slow speed belted to countershafts, some simple non-condensing, where compound condensing would be decidedly best.

I know of at least three plants located in water-works pumping stations using high speed simple non-condensing engines on a practically steady load, all of which have been erected during the past three or four years.

Two stations I remember having an all-night and every-night load of arc lights, and situated on a lake shore, which run high speed simple non-condensing engines.

To offset this there is one station that deserves mention, as it embodies many points of value. The building is substantial, of brick, two stories high and well set, the engine is a moderate speed compound condensing, with shaft extended for three dynamo pulleys, and one for the power condenser. There is a heater between the exhaust and condenser, and a power pump attached to one side of the condenser. The flow to the boilers is governed by a by-pass valve, as the pump is, of course, in motion all the time the engine is running. This station has only an arc load and runs all night; it was built entirely under the supervision of a local mechanical engineer, with the exception of connecting the lines and dynamo terminals to the switchboard, and would, I think, be hard to beat for results.

ARRANGEMENT OF MACHINERY.

The arrangement of machinery is as diverse as the style of motive power; when direct belting is used the arrangement is generally simple and plain, but oftentimes so crowded as to be very inconvenient.

There seems no end to the arrangement of shafting; some have a line shaft through the middle of the dynamo room, and belt both ways to dynamos; others a shaft on either side of the room, belting to dynamos in the center; others the shaft under the floor, belting up to dynamos, and occasionally to engines also; others have the shafting overhead; in fact, there is no end to the styles, some good and some bad. In most cases friction clutches are used with shafting for stopping individual dynamos, and some few may use loose pulleys on independent sleeve for the same purpose.

The length of belt centers varies greatly, some apparently thinking if long belts are better than short, very long ones must be much the best.

The improvement in switchboards seems to me more marked than in any other department, which is probably owing to the pressure of insurance men, who look at the switchboard as the most dangerous fire risk of all.

LINE CONSTRUCTION.

In line construction I cannot see that any very marked improvement has been made, excepting, in some cases, the substitution of larger and better poles for the older ones.

The use of black covered wire in place of white has, perhaps, made the lines a trifle less conspicuous; but that is about all. The lines still have the apparent aimlessness of direction mentioned by Prof. Thomson, at Buffalo.

People in the larger interior cities are already agitating the question of underground wires, and it seems probable that unless something is done soon by the companies themselves to rid the streets of the more conspicuous of these wires, there will be very costly trouble for them to contend with.

It can no longer be denied that wires are working well every day in subways, and the only valid argument against them is extreme cost. Nevertheless, when the general public learns this fact, cost will have little to do with the argument.

In many places wires can be removed from the main streets to alleys back of the shops, and the extra cost will be decidedly cheaper than underground work. In such few places as have already done this wires are inconspicuous and the underground question is never raised.

In street lighting the favorite method is the cable suspension across the street. Where the work is neatly done this serves very well, but it would be difficult to find a more unsightly thing than some of the lamps so suspended.

Considerable trouble is occasioned in the above method by breakage of the wires at the joint with the line and at the cross bar over the hood. There is no apparent reason why twin or duplex wire should not be more used for this purpose, instead of the kinked and straggly single wires.

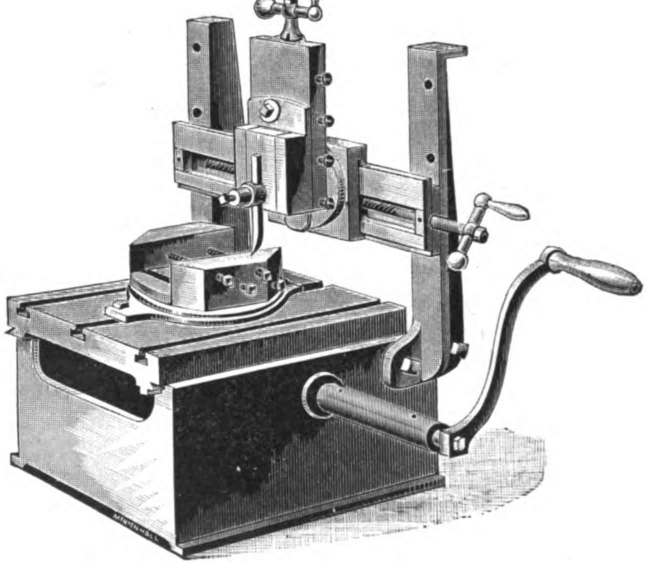
There are many other methods, some of them good in principle but bad in the application, and so it goes.

It seems to me that if some action was taken by a non-partisan association like this Institute, an advance toward better engineering might be made, if a few general laws could be suggested to be followed in laying out the different parts of a lighting station. Perhaps it may be said that much of the above work should more properly come before the National Electric Light Association, but as many of that society are members of this Institute, I feel sure they would individually appreciate its backing in the future when the time comes for enlargement, and they have need of combined expert opinion.

[The foregoing paper was read before the American Institute of Electrical Engineers.]

SHEPARD'S HAND PLANER.

Mr. H. L. Shepard, of Cincinnati, O., has placed on the market a hand planer, the design of which is shown in the illustration with this article. Its accurate work, great speed and ease of movement, and its moderate price, place it in the power of anyone to complete his outfit by adding a tool that cold chisel and hammer and file will not take the place of. For schools, for model shops, for inventor, it is an undispensable tool. A universal planer chuck is furnished with each machine. If desired countershaft, power and automatic cross feed can be furnished at a small addition to the cost of the planer. These planers are of two sizes, No. 1 is 12" long, 9" wide and 8" high. No. 2 is 24" long, 12" wide and 12" high. The same shops also turn out a power planer of two sizes which meet many needs and will answer the purpose of many high priced machines. Shepard's new lightning double reverse 20" lathe, which he has been perfecting for some time, also containes some very desirable and valuable improvements. Any special information as to lathes and planers will be furnished on application to the manufacturer.



A SET OF FINE TOOLS.

BY WM. HARRISON.

[Let not the reader whose taste does not run to that which diverts as well as instructs the minds, and who shuns fiction as unprofitable stuff, think that he will violate his custom by perusing Mr. Harrison's paper. It is essentially true, and those who skip it will miss a narrative that substantiates the saying that "Truth is stranger than fiction."—Ed.]

RECAPITULATION.

Charles C. Adams, a mechanical engineer and instructor in a technical school, is reduced by sickness and his bad financial management, to distress. While in these straitened circumstances, a gentlemen, calling himself John W. Ellis, visited him and gave him employment. The work was to make from certain drawings a set of tools, which, Mr. Ellis explained, were to be used in constructing the model of a very important invention. There was to be absolute secrecy. Five hundred dollars were paid down, and as much more when the work was finished. The job took about a week. Ellis set the price himself, and the reasons he gave for paying somuch satisfied the maker.

Mr. Adams now had not only sufficient funds to relieve the distress of himself and parents, but was able to develop an invention of his own. He was a most prolific inventor, but only this one patent was commercially valuable. He went ahead with it and in a short time became wealthy. The strain of providing a competence for himself and parents being now eased, he devoted his attention to a young lady, Miss Ludlow, whose hand he asked in marriage. The lady herself was quite willing, but the father was in no haste to accord his consent. On the occasion of the interview between Mr. Adams and Mr. Ludlow, on the subject, which it was expected would be final, the latter produced a pair of long forceps, which had been left behind by a burglar who raided a neighbor's house, and showed the astonished young inventor and manufacturer the name of "C. C. Adams, Detroit, Mich," stamped in the steel. There was no doubt that the instrument was one of the set made for the alleged purpose of constructing a model, nor that Mr. Adams had, instead of handing the blacksmith the stamps furnished him for this purpose by Mr. Ellis, substituted his own for them unwittingly, with the result that his name was on every piece of a large kit of unusually fine and dangerous burglars' tools. He is in an uncomfortable position and can not make Mr. Ludlow believe in his innocence. When suffering the worst from the unfortunate dilemma, he is suddenly introduced to Mr. Ellis, at a party at the Brunswicks, as S. V. Ashton. He has an interview with Mr. Ashton and one Mr Bellknap, and is quite well satisfied that the former is straight, notwithstanding the evidence against him. With an ingenious excuse, he gets a promise from Ashton to bring the tools to his office, and goes home much relieved. But when the time comes for delivering them he receives a letter that every one has been stolen. Mr. Ashton and Mr. Belknap had discovered that Mr. Adams' stamp had been used on the tools and they decide to make him pay dearly for them.

But Mr. Adams worked away, thinking that absorption in his duties would relieve the strain on his mind until Mr. Ashton paid him the promised visit and informed him of the nature of the occurrence which was thought to be worse than the loss of the tools.

He had to attend a meeting of the committee appointed to devise ways and means for the establishment of a machine shop-school, where poor boys who wished to learn to be machinists and engineers but could find no place to serve an apprenticeship, might be educated in practice and theory and at the same time earn a small salary. He did not feel much like going just at that time, but being chairman he could scarcely remain away without damaging the prospects.

A few days before this incident, for want of something to settle his mind upon, he wandered out through the shop, noting as he passed, the fact, that young Sidney was doing very good work on the big lathe, and into the engine room.

The engineer's face was rather cloudy when Mr. Adams entered, but on seeing the president of the company in his quarters, which was not an unusual occurrence, he brightened up quickly. Mr. Adams greeted him pleasantly, asked how the new heater worked, and after looking at engine for a few moments, passed into the boiler room. In the corner, on an old nail keg, sat a young man—scarcely a full grown boy.

"Joe, better see to the fires," said the engineer in a tone that revealed his pride in the authority he exercised.

Joe, the fireman, arose from his keg, laid down a book and renewed the fires, which really required no coal just then. While Mr. Adams and the engineer were conversing, some one called the latter away and Mr. Adams looked around at Joe. The boy had rather a down cast expression, but was intently reading.

"Well, Joe," said the inventor, approaching the keg, "may I see what literature finds favor in the boiler room of this plant?"

"Joe looked up apprehensively and handed Mr. Adams the book, or rather the part of a book in magazine form, in a manner not a little embarrassed.

"*Maxims and Instructions for the Boiler Room,* by Hawkins. I must congratulate you upon your happy and wise selection," he said. "How do you get this, Joe?"

"A man came around and wanted Mr. Barnes (the engineer) and myself to subscribe for it. It comes in parts, at 25 cents each, and did not take much money at a time, so I subscribed. Mr. Barnes did not take it. He said he had more books than he could read and that I could learn more by seeing how he did things, than by reading papers and books. He said, too, that very likely I would never get more than a few of the parts. But I liked the books and the name of it and subscribed, and I have now got six. I suppose I am foolish to read them, for I know I ought to work instead of read, and may be I will get lots of nonsense out of them into my head, as Mr. Barnes says, but I would rather read them than do anything else, and I think it does me some good."

Joe had said more than he intended to when he started, and now that he had delivered himself of this information he felt uneasy.

"Joe," replied Mr. Adams, "your superior did right in advising you as he thought was to your best interest. He probably had not read any of these, or he would not have cautioned you in that way, for the work is one that will do you and every mechanic good."

Joe was much relieved and summoned courage to ask a question which Mr. Barnes had not been able to explain to him so that he could understand it.

"I would like to ask you," he said, "what makes the difference between these boilers and those at the Richardson Works. Our two boilers are 90 horse-power each, and we get 175 horse-power. The Reynolds works across the street have two 90 horse-power boilers just like these and they develop 175 horse-power, too. But we use more steam and coal then they do. I don't mean to say that these are not good boilers, but I would like to know why the others do more work than these?"

Mr. Adams listened attentively to Joe and when he had finished, said: "I will be very glad to do so, Joe, but perhaps I can explain it to you better if you come over to my house some evening next week—any evening you wish to, except Monday, Friday or Saturday; I live at No. 60 Villa street. The reason is that the Richardson Works have a Corlisss engine, while our engine is a plain slide valve. I am glad to see that you think about such things. Just ask for an explanation of every point or operation about the plant, however simple, that you do not thoroughly understand."

"I like that boy," thought Mr. Adams, as he walked away. "He seems much more progressive than the engineer. If he takes the trouble to come over to my house I shall see that he has a thorough training in steam engineering."

Joe was the son of a poor woman who had a hard life of it. Her husband was a drunkard, and Joe, the oldest boy, had just left school and begun work firing. Like all boys he enjoyed recreation and the open air, and was frequently on the commons, of an evening, playing ball. He was out participating in the popular game the next Tuesday evening following the conversation with Mr. Adams, and the club he belonged to was beaten for the first time. They all felt the sting, and were determined to retrieve the defeat on the following evening. But Wednesday evening was rainy, and it was tacitly understood that the game would be had Thursday evening. Joe recollected that this was the last day in the week that was open to him for a lesson on Corliss and slide valve engines. He wanted to learn about engineering, for he realized that his mother needed all the help he could give her, and he wished scarcely less to win back the reputation of his club. He explained the situation to the boys, and they ridiculed the idea of giving up the game, telling him that he could go next week just as well, to say his mother was sick or give some excuse that would let him out. Joe went home resolved to engage in the game, but before his supper was finished an old saying he had heard his mother repeat—"Work before play"—came into his head, and stuck there so persistently that he changed his mind, and sent word that they would have to get along without him.

It was more fortunate for Joe than he knew that he denied himself this pleasure to attend to business, as will be seen hereafter, and he never failed in future years to impress upon boys that by neglecting duty at any time the opportunity of their life might be thrown away without their knowledge. If Joe had not gone to Mr. Adams' house, he might never have known what he missed, but as he did go he saw very plainly how an apparently trifling incident shaped his destiny for the better and started him up the hill of success; for had he let those days expire without availing himself of the invitation, Mr. Adams would have taken no more interest in him, receiving his excuses pleasantly, and giving him the lesson, but letting it drop at that point.

In Mr. Adams' den, or private experimenting room, were two working models, one of a Corliss and the other of a slide valve engine, showing a vertical section through the cylinder of each. To these he directed Joe Miller's attention.

"I might go into figures and big words to explain this—and really it would be the easier way," said the inventor, "but I will use a method adopted by an old engineer who knew no algebra nor theory, but only common arithmetic and common sense. This showing, however, I may say, is the most favorable possible to the Corliss. I have ascertained exactly the size of our engine and the size of the Corliss engine at Reynold's mill. You are right in stating that they have duplicate boilers and develop the same horse-power, and that we use considerably more steam than they do. For example we will take two engines 16"x24" using steam of 100 pounds pressure. The Corliss cuts off at ⅓ stroke or 8". The mean effective pressure would be 70 pounds. Now if the ball governor engine should take steam full stroke, and the wire draw it down to 70 pounds by the ball governor, we should have as follows:

"The area of 16"=201" and, in Corliss engine, cutting off at 8" or ⅓ of stroke, we would have 201"×8"=1608 cubic inches of steam that would develop 70 pounds mean effective pressure.

"With a ball governor and wire drawing the steam to 70 pounds, we would have 201"×24"=4824 cubic inch to make a mean effective pressure of 70 pounds. There are 1728 cubic inches in a cubic foot of steam, and, at 100 pounds pressure, there are 1184 units of heat in a pound of steam by weight. But we use only 1608 cubic inches of steam in the Corliss. $\frac{1608}{1728}=.93$ of a cubic foot. Now a cubic foot of steam at 100 pounds pressure, according to the table properties of steam, weighs .2640 lbs. .93×.2640=.2455 pounds of steam to make a mean effective pressure of 70 pounds in a Corliss engine. And with ball governor engine, we have 4824 cubic inches. $\frac{4824}{1728}=2.213$ cubic feet. This (2.213) multiplied by 2640, the weight of a cubic foot of steam, gives 5831 pounds of steam in the ball governor engine, against 2455 pounds inthe Corliss."

When Joe arose to leave something he had heard but not regarded as being in any way connected with Mr. Adams, came into his mind. It occurred to him that it would do no harm to tell, so he said: "Mr. Adams, a friend of mine was telling me last Saturday night about a fellow who wanted to hire him to pretend that he had stolen some tools from a room in a block on ——— street. He said they belonged to a man by the name of Adams. He promised to pay Bob a lot of money for it. I don't just remember what he wanted Bob to do. Bob said he would not do it, but I just wondered whether it had anything to do with you, or any of your folks."

Mr. Adams thanked him, said that he guessed not, and bade Joe good evening. But before the boy had reached the gate, it struck him that this *might*, after all, have something to do with him, so he called Joe back and questioned him more carefully. Joe could remember no more of the circumstance than he had related, but by chance he had seen the gentleman who made the proposition to Bob, and described him.

"It is Harry Bellknap," exclaimed Mr. Adams, his face turning pale. "I see it all now. They have discovered that *my* name is on the tools instead of Ellis's and have decided to bleed and incriminate me."

Then turning into the house, he said: "This is information in the niche of time. *I will have those tools in 24 hours.*"

He grabbed his hat and, in company with Joe, walked briskly away.

(To be continued.)

HOW GOLD ORE IS SMELTED.

After the gold ore has reached the smelter, being weighed, sampled and separated into piles for the various bins, each pile is pulverized in a machine that works upon the principle of a coffee mill. From this sample three or four paper sacks are filled, of which two are sent to the assay office, one to be sampled, the other filed away. The third sack is sent to the shipper of the ore. Each sack is marked with the shipper's name, name of mine, if given by shipper, lot number, car number, if any, and date when sampled.

If the ore is very lumpy, it is crushed before sampling. This unloading into a bin is continued until the bin is full, and it may hold anywhere from 500 to 3,000 tons. When filled, the superintendent obtains a list of all ores, and weights of lots that have gone there, which constitute what is called a mixture. This list he takes to the assay office, and gets an average assay on the silver, gold, lead, zinc, iron, lime, etc., in order that he may know what to add in order to make a good smelting charge. Separate piles of lead and ore are made, to supply the furnaces when needed. The superintendent makes out a list of the different mixtures and the weight from each that are to constitute a furnace charge. About 800 pounds of ore, 150 pounds of lime, 200 pounds slag and 150 pounds of coke go to make up a charge.

This is, of course, varied in accordance with the character of the ore. Each furnace will treat from 150 to 200 tons of these charges in 24 hours. The lead in the mixture when treated in the furnace runs down into the bottom, carrying with it the precious metals. The slag being lighter floats on top of the lead and is taken off through a tap hole. The lead, or rather the bullion, is dipped out of a well in the side of the furnace and poured into molds. After cooling, the bars are taken out and sampled, a hollow punch being used that brings out a small core. It is usual for convenience to sample the bars in lots of 300 each. The punchings of each lot are assayed to determine their contents. The bullion is now ready for market, or for further treatment.—[Leadville (Col.) Herald.

Inventions that Paid.

The popular "return ball" yielded the patentee an income of $50,000 a year. The "Dancing Jim Crow" top was worth $75,000 a year to its inventor; the spring window shade, the stylographic pen, the marking pen, and rubber stamps, each $100,000 a year. The common needle threader was worth $10,000 a year to the man who first thought of it. The rubber tip on lead pencils, the gummed newspaper wrapper, the machine for making type, made rich men of their originators.

Silverton sold his patent for copper tips to children's shoes for $67,000. Waterman's process for tempering wire netted him $83,000. Plimpton, the inventor of roller skates, made over $1,000,000. Burden realized a profit of $90,000 from his invention in horseshoes. Hoe's printing press made him in 14 years $248,000.

THE editor acknowledges a fine box of selected graphite pencils from the Joseph Dixon Crucible Co., of Jersey City, N. J.

Nickel Plate Excursion to Niagara Falls, July 21st.

Special trains leave Lorain street, 5 and 10:35 A. M; Pearl street, 5:10 and 10:42 A M; Cleveland Depot, 5:30 and 10:55 A M; Wilson avenue, 5:35 and 11 A M; Madison avenue, 5:40 and 11:04 A. M; Euclid avenue, 5:55 and 11:11 A. M. $3 round trip. Tickets good five days.

Daylight Excursion to Niagara Falls.

The first daylight excursion to Niagara Falls via Nickel Plate will leave Cleveland, Thursday morning, July 21st, at 5:30 and 10:55 A. M., arriving Niagara Falls 1:40 P. M, and 8:40 P. M. Special train returning leaves Niagara Falls 7 P. M. same day. Tickets good returning until July 26th. $3 round trip. Toronto $1 extra. Chautauqua Lake free. Tickets for sale by all Nickel Plate agents.

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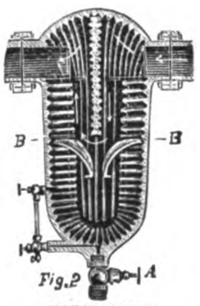

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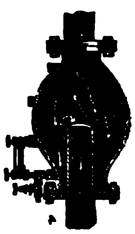

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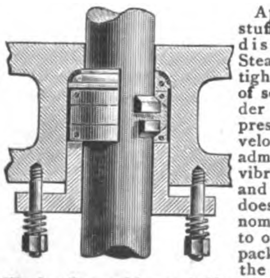

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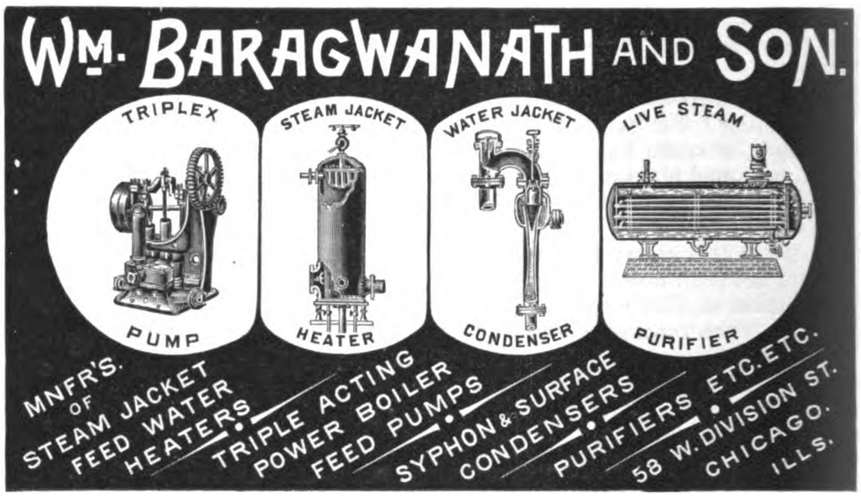
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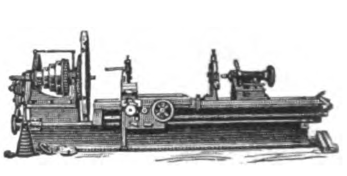

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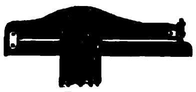

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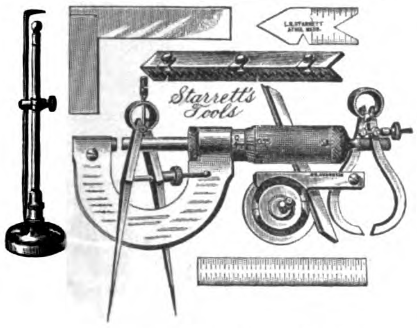

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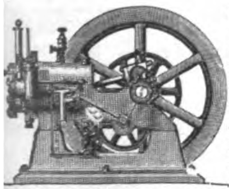

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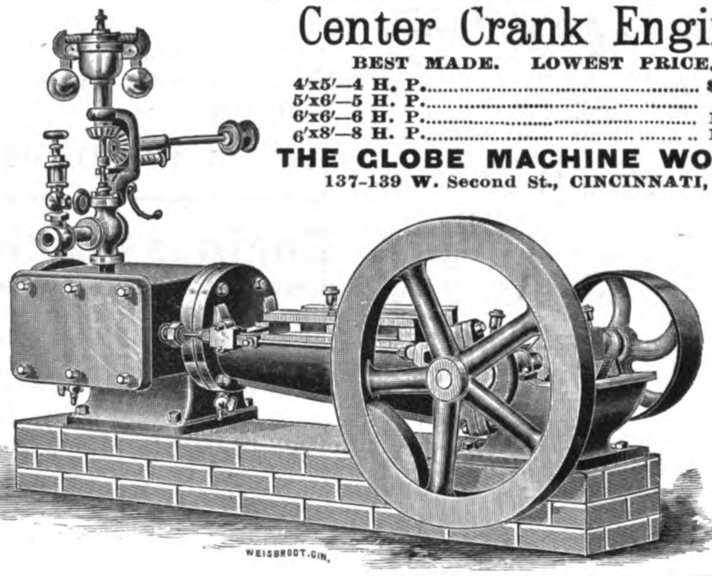
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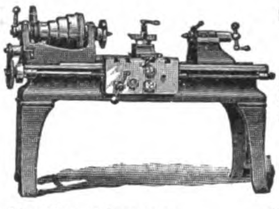

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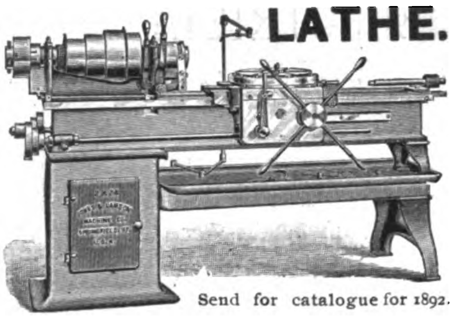

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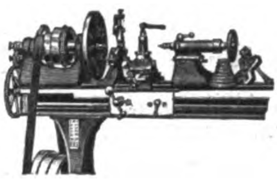

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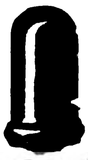

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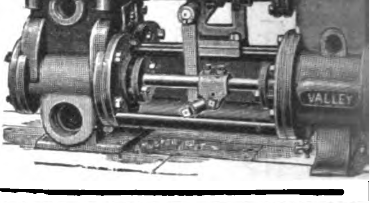

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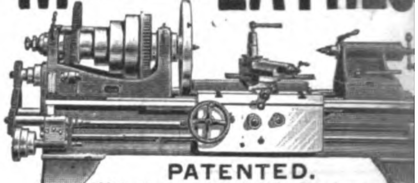

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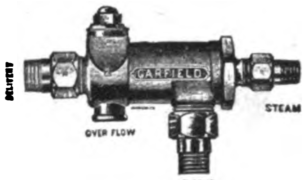

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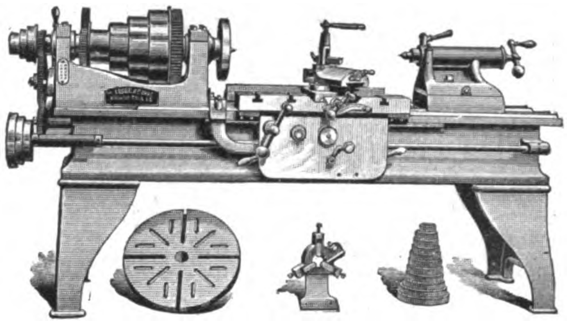

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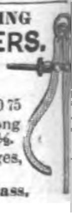

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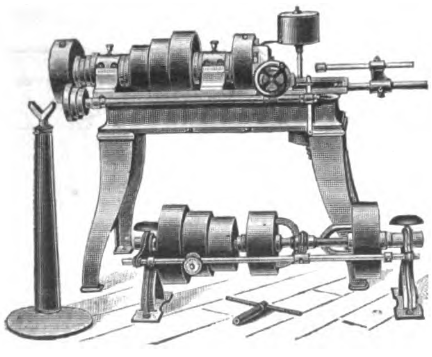

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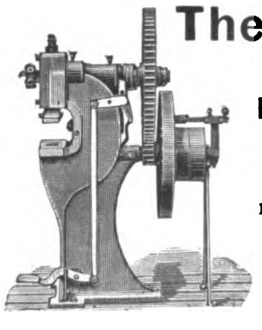

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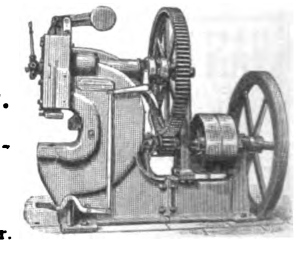

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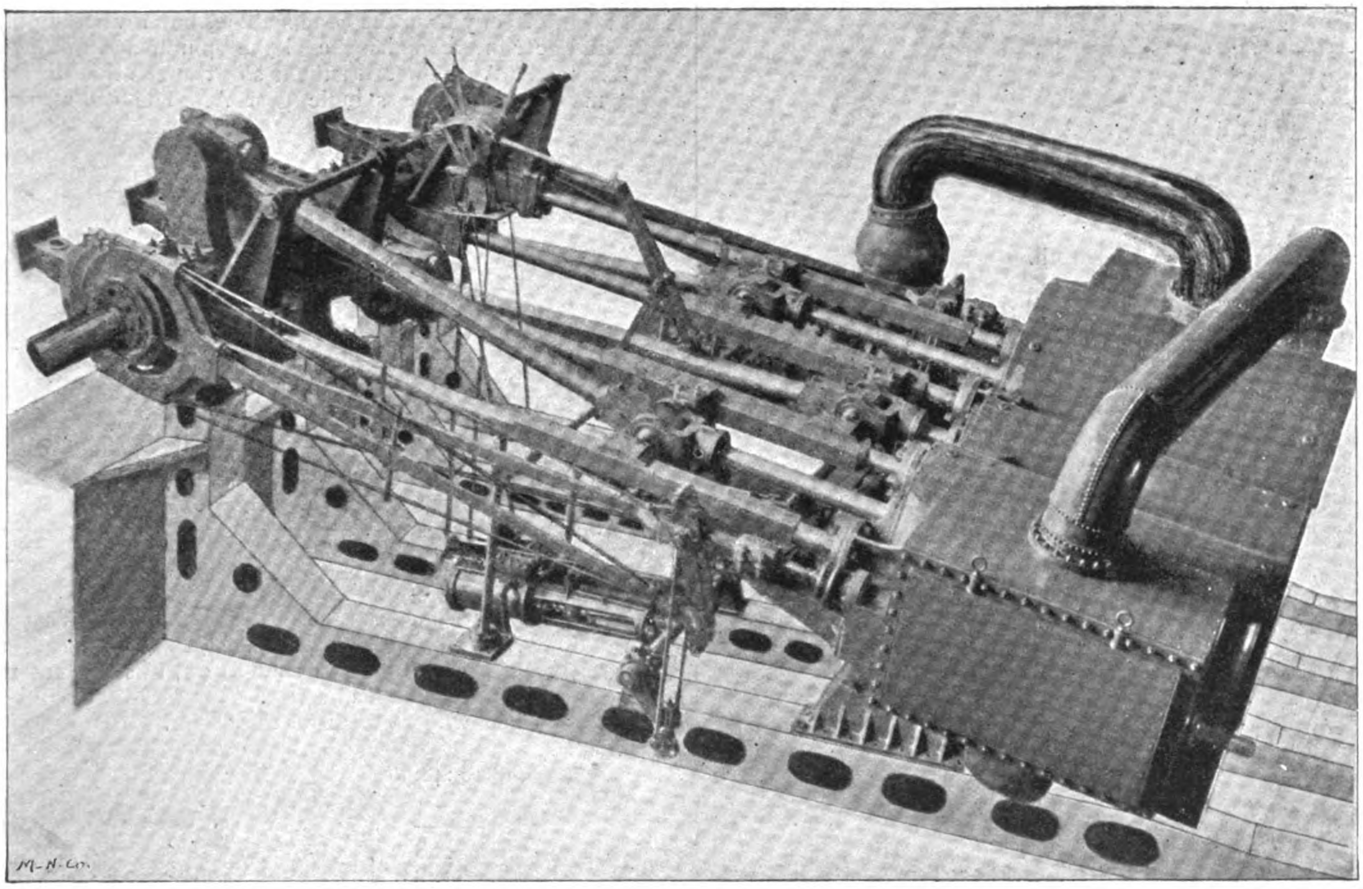
INCLINED, TRIPLE-EXPANSION ENGINE.

The machine illustrated by the engraving on this page, is believed to the first inclined, triple-expansion, three-crank engine built, and great edit is due to designers and builders for turning out so complete an gine of an entirely new type—a type which is thought to be the coming ne for high-speed, economical, side-wheel steamers.

The cylinders are 26", 42" and 66" diameter, by 72" stroke. The gh-pressure cylinder is placed between the intermediate and low-pressure linders, and has a piston valve actuated by a Joy radial valve gear; the termediate and low-pressure cylinders have double-ported slide valves d ordinary link motion. The steam pistons are made very deep and ve a special arrangement for taking up wear; the piston rods are of eel; connecting rods, guides, shafts and crank pins of scrap iron forgings; d cranks of steel castings. The crank pump is operated independent of e main engine, and is of the duplex type; having 14-inch steam cylinders, 20-inch air cylinders, and 20-inch stroke. The wheels are of the thering type, 19½ feet outside of floats, which are of steel 9½ feet wide, re being nine to each wheel. The manner devised by the engine build- for supporting the engine in the hull is noteworthy, from the fact that re is a total absence of vibration, even when running at highest speed. is was accomplished by a judicious combination of partial horizontal and tical bulkheads. Two boilers 10 feet 10" diameter by 21 feet long, of gunboat type, furnish steam at 160 pounds pressure. Each boiler has ee 46" furnaces, and they are run with natural draught. On trial these gines have developed 1,641 indicated horse-power, running at 40 revolu- ns per minute.



INCLINED, TRIPLE-EXPANSION ENGINE.

A feature of this type of engine is the very small amount of space en up on the main deck, being merely room for cranks to turn, and for erating-platform back of cranks. Ventilating trunks only are run up ough the upper deck.

The Cleveland Shipbuilding Co. are the builders of this engine, which s designed by Mr. A. Angstrom, of that company.

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Neither Sickels nor Corliss was first to use a governor to determine the point of cut-off in regulation of the speed of the engine. That was done at least as early as 1834, and by Zachariah Allen, of Providence, R. I., and possibly by others; but Mr. Corliss was adjudged by the courts to have been the first to attach the governor to a *detachable* valve gear. In this the courts were sustained, I think, by the judgment of the best informed members of the engineering profession; but the dashpot was no new thing, and was not adjudged exclusively his, except as applied to his peculiar form of valve gear. The device was covered by the Sickels patents of 1841, and open to the world after their expiration. It had actually been in use long before the Corliss inventions were brought into practice. —[Thurston.

Cyrus W. Field died a poor man, his sole remaining provision for his family being life insurance policies which will realize some $45,000, a mere bagatelle to that which he once possessed and which he might have had at his death had not the confidence he had given been so basely abused.

SCREW CUTTING.—I.

BY AN OLD CONTRIBUTOR.

To calculate the gears of a lathe, says *The Mechanical News*, from which journal was procured the cuts herein, to cut any thread within its capacity, when motion is taken from the cone spindle directly, and the wheels are "straight" geared.

Rule. Select any convenient gear for the cone spindle, and multiply the number of teeth in this gear by the number of threads per inch to be cut, and divide the product by the number of threads per inch on the lead screw.

Example. The lead screw has 4 threads per inch, and we wish to cut 18 threads per inch; what gear must we select? Select at random a wheel having 16 teeth for the spindle.

Then,

4:18: :16:72
16
108
18
4)288
72 for the lead screw. Ans.

The ratio of velocity between the lead screw and spindle must equal the ratio between threads per inch to be cut and threads per inch on the lead screw. In the above example the ratio between threads is $\frac{18}{4} = 4\frac{1}{2}$; and the ratio between wheel teeth is $\frac{72}{16} = 4\frac{1}{2}$.

Example. The lead screw has 4 threads per inch, and we wish to cut 2 threads per inch, what gear must we select? We select at random a gear of 72 teeth for the spindle.

Then,

4:2: :72:36
2
4)144
36 for lead screw. Ans.

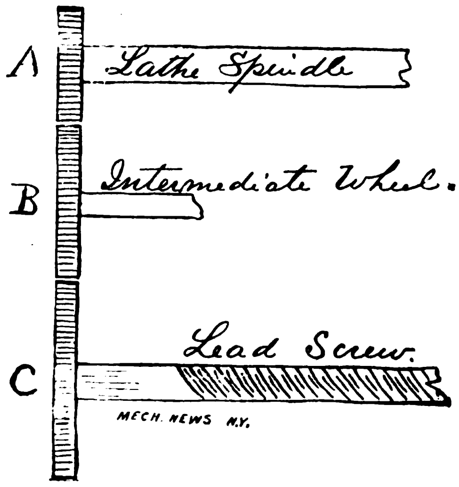
$\frac{4}{2} = 2$ ratio between threads.

$\frac{72}{36} = 3$ " " wheel teeth.

Or, 36 for the spindle and 18 for the lead screw will answer as well as 72 and 36. In fact, any two wheels of convenient size, whose teeth bear to each other the same ratio that 1 bears to 2, will answer the purpose as well as 72 and 36.

The following cut shows a lathe "straight" geared for screw cutting, with motion taken from cone spindle directly.

In the foregoing train of wheels, A is the driver and C the driven gear. The wheel B cuts no figure in calculating the gears to cut a thread.



It is obvious that when the threads to be cut are finer than the threads no the lead screw, the larger gear must be placed at C, or, on the lead screw, and vice-versa.

Example Required the gears to cut 11½ threads per inch, the lead screw having 8 threads per inch.

Select 32 at random.

Then,

8:11½: :32:46
11½
32
32
16
8)368
46 for lead screw. Ans.

Example. Required the gears to cut 32 threads per inch on above lathe?

Select 24 for cone spindle.

Then,

8:32: :24:96
24
128
64
8)678
96 for lead screw. Ans.

Example. Required the gears to cut 3 threads per inch on above lathe?

Select 64 lathe spindle.

Then,

8:3::64:24
3
8)192
24 for lead screw. Ans.

Example. Required the gears to cut 8 threads per inch on above lathe?

Select 48 for cone spindle.

Then,

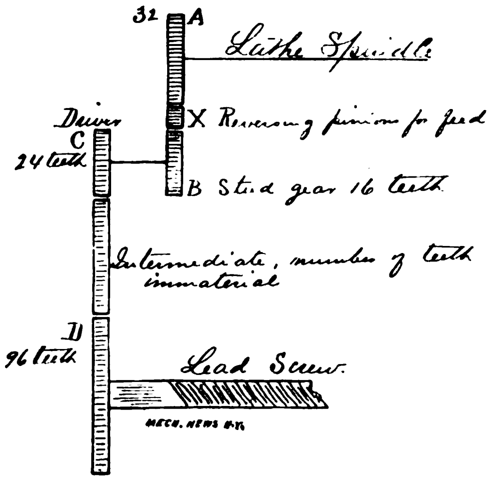
8:8::48:48
8
8)384
48 for lead screw. Ans.

To calculate the change gears for a lathe, to cut any number of threads per inch within its capacity, when the wheels are straight geared, and motion is NOT taken directly from the spindle.

Rule. Figure out the gears according to the preceding rule, and add to or subtract from the number of teeth in the driving gear, as the stud gear has a greater or less number of teeth than the gear on cone spindle.

The following cut shows a "straight" geared lathe when the motion is not taken directly from the cone spindle, but reversing pinions for feed, and a stud gear intervene between lathe spindle and driving gear of train.

Example. A screw feed lathe is so arranged that the stud gear B has half as many teeth as the spindle gear A. The lead screw has 8 threads per inch, and we wish to cut 16 threads per inch. What gears must we select to do so? As we must cut twice as many threads to the inch as there are threads per inch on the lead screw, it is evident the work must revolve twice as fast as the lead screw.



Select a wheel with 48 teeth for the driver.

Then,

8:16::48:96
16
288
48
8)768
96 on lead serew.

But, since the driver would make two revolutions to one of the spindle, we must reduce the number of its teeth one-half. Consequently, the gears should be 24 for the driver and 96 for lead screw.

Proof. While 96 makes one revolution, 24 makes 4 revolutions; and 16 being secured to the same stud with 24, also makes revolutions, while the spindle gear having twice as many teeth as 16 would make two revolutions, the number required.

The ratio of threads is 2; and the ratio of speeds is 2, also. Thus we have: Drivers, 32 and 24; Driven, 16 and 96. By cancellation we see that the sum of the drivers is contained in the sum of the driven, twice, making the ratio 2.

(Concluded next month.)

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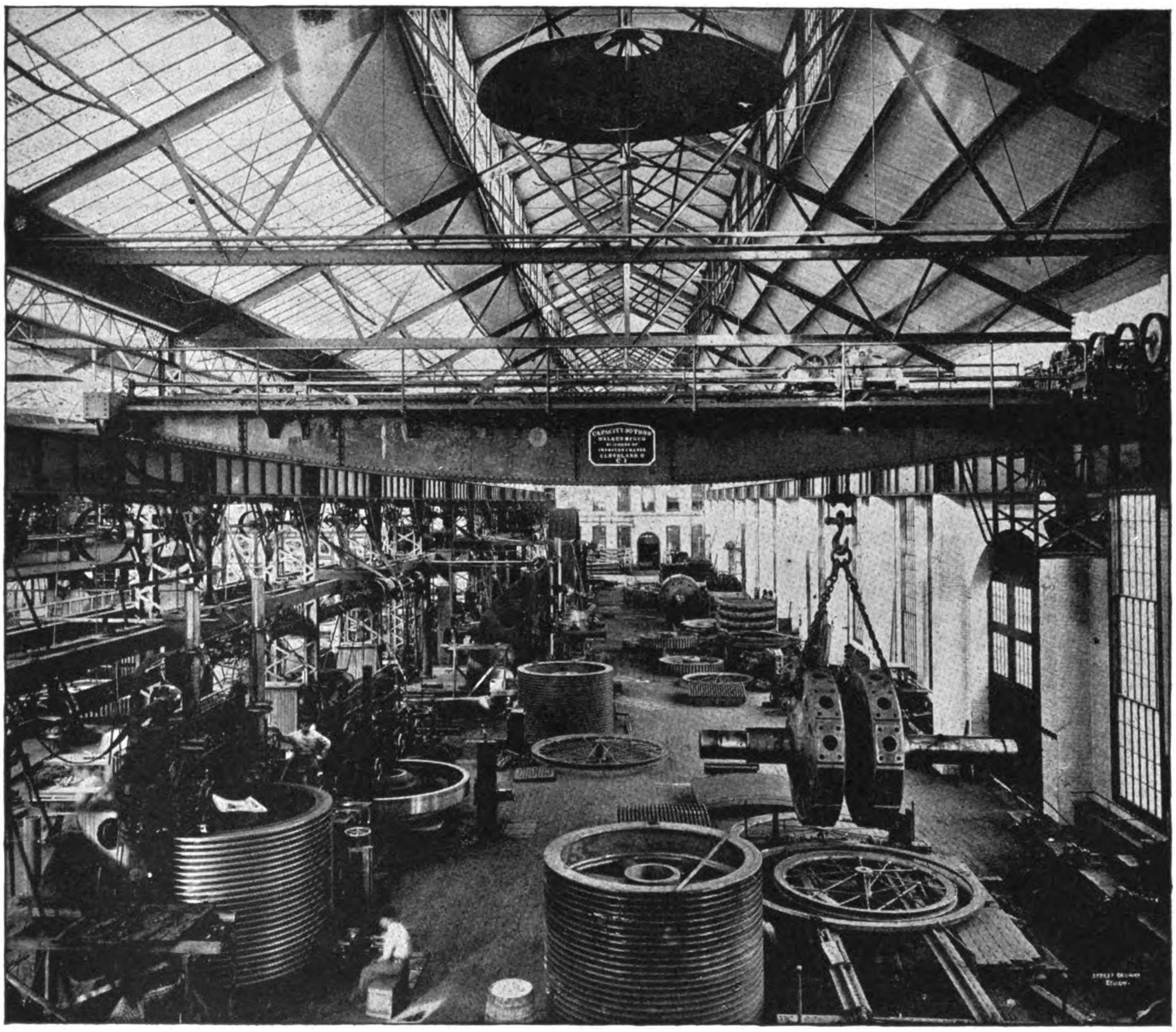
THE WALKER MANUFACTURING CO.'S NEW MACHINE SHOP.

Two of the requisites for the manufacture of cable plants seems to be the use of large machinery and extensive buildings. Indeed it must require ingenius contrivance and the best of management to do the work of the Walker Manufacturing Co. without spreading over many acres of ground.

The new machine shop of this concern is one of the grandest achievements of ingenuity of the age for operative convenience and power. No one portion of the shop conflicts with another portion. What has not been accomplished by the inventive genius of Mr. Walker and executive ability of his able assistants, Mr. Bryant, Mr. Bone and others of the management, would be hard to find in the whole world of similar emergencies.

The shop is in three sections or bays, as they are called. Each bay is 57 feet wide, two are 288 feet long and the third is 430 feet long and the extension altogether is 500 feet. From the floor to the highest roof point is 54 feet. Massive iron pillars support the glass roof, as can be seen by reference to the engraving accompanying. The cost of the glass in the roof of this shop and the foundry was nearly $14,000. Each bay has a traveling crane capable of lifting 30 tons and moving it from one end of the building to the other. The cranes have many improvements and are built at the works. A cage on the crane is situated conveniently for operation of the big machine. In this cage the operator is stationed, and by the movement of levers he controls all the movements of the ponderous machine. The motive power is a small engine, which is situated in one corner of the shop, and is transmitted by a rope.



THE WALKER MANUFACTURING CO.'S NEW MACHINE SHOP.

The cotton ropes which are used in operating the cranes were made in England and imported especially for this purpose. The length of rope required for the nine new traveling cranes is 2¼ miles, and when in motion will travel at the rate of 3,000 feet per minute. A specially constructed device for maintaining the proper tension of the rope is fixed at one end of the room, and consists of four grooved wheels placed one above the other. Around the top one the three ropes pass, and once around the other three, and when in operation these so adjust themselves so as to keep each of the ropes at the proper tension required.

For the convenience of vise-hands a gigantic bench is provided. Its entire length is 402 feet and its breadth four feet. Here are all the most modern tools and appliances, some of them made specially for the Walker company, and many the devices of Mr. Walker. The shop is heated by steam and at night light is furnished by gas and arc electric.

In the erecting bay there is an erecting pit 49 feet long, 22 feet wide and 8 feet deep, in which to erect "cable plants," and other heavy and large machinery.

In the long bay there is a pit lathe 40 feet long, 12 feet wide and 16 feet deep, in which can be turned a drum or gear 32 feet in diameter and 8 feet wide.

The motive power for these tremendous machines comes from a 24x48-inch cylinder Corliss, with a 16-foot fly-wheel. The steam is generated in two boilers of 200 horse-power each and equipped with Brighton stokers. Feed water comes from a 20-foot cistern, into which the roof drainage and condensed steam is returned.

Among the work recently completed may be mentioned four 32-foot diameter rope wheels, 6-foot-1-inch face, with 32 grooves for 2¼-inch ropes; four 32-foot rope wheels, 8-foot-4-inch face with 34 grooves for 2-inch rope, finished weight about 100 tons; two 32-foot diameter rope wheels, 3-foot-3-inch face, with 13 grooves for 2-inch diameter rope, finished weight of each being about 40 tons; four 26-foot diameter rope wheels, 4-foot-11-inch face, with 20 grooves for 2-inch diameter rope, finished weight of each being about 60 tons; four 22-foot diameter rope wheels, 6-foot-1-inch face, with 22 grooves for 2¼-inch diameter rope, finished weight of each being about 50 tons; four 9-foot diameter rope wheels, 6-foot-1-inch face, with 22 grooves for 2¼-inch diameter rope, finished weight of each being about 22 tons; 18 1,000 horse-power friction clutches, to operate and transmit this power at 55 revolutions per minute; four 500 horse-power friction clutches, to operate and transmit this power at 55 revolutions per minute; 14 large spur gears, 14-foot diameter, 104 teeth, 16-inch face, 5-inch pitch; seven large spur pinions, 9-foot diameter, 62 teeth, 16-inch face, 5-inch pitch; one 20-foot diameter band wheel, 50-inch face, built up in segments, the finished weight will be about 27 tons; one 20 foot diameter band-wheel, 44-inch face, made in halves, the finished weight of which will be about 30 tons. This band wheel is designed to run at a speed of 125 revolutions per minute, which is equivalent to 7,854 feet periphery speed per minute, or nearly a mile and a half per minute.

Mahogany Sawing.

Mahogany of the first grain and marking is sawed up into veneer by half a dozen sawmills in this town. Mahogany sawing is a very pretty business, and a mahogany sawyer is a well-paid man of great skill and long experience. He must know whether a log is suitable for veneer or slabs; must be able to guess whether its heart runs straight or "dips;" must see far enough into a log to decide whether it shall be cut transversely before being sawed lengthwise and whether it shall be quartered as oak is quartered or sawed straight through with the grain from end to end.—[New York Sun.

A flour mill trust would undoubtedly be a grinding monopoly—[Albany Telegram.

SCIENTIFIC MACHINIST

Formerly, WESTERN MACHINIST.

DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES.
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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, AUGUST 1, 1892.

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COMMON FOLKS.

One of the blessings of a mechanic's life is exercise. An accompanying blessing is condescension and common sense. It is not necessary that a mechanic should be a poor man, but it is necessary that he should fear neither work nor dirt. It is also necessary that he should be endowed with a good deal of intelligence of a practical sort.

There is so little vanity in this branch of industry that mechanics everywhere, all over the world, are free from that malady known as "social discretion," which prevents a neatly dressed person from recognizing a workman who is dressed in a working suit. You may be ever so deep in the soot and grim of a busy shop, or even at the bottom of a sewer, and still he is not afraid to take you by the hand and welcome you into his own society in the face of a world of society nonsense.

There are no natural human cliques, social distinctions are unnatural, and the mechanic knows it. A mechanic is a philosopher. Philosophy teaches him that there should be no tight board fence between the professions and the trades, between the Jews and the Gentiles of society, between the gentry and peasantry of this homogeneous, earthen earth.

In fact, the mechanic is purely American. This Republican government was founded by just that kind of spirit of common sense which reigns supreme in the mind of every true mechanic, which fires with courage the breast of every industrious honest laborer, and which infuses a purifying element of ambition for principle into the body politic of this entire nation of ours.

MACHINERY WOOD.

Are any laws being enacted for the preservation and perpetuation of certain hard woods that are essential to the manufacture of certain kinds of machinery? No. Nevertheless some forest laws must be passed before much effective work will be done to prevent the hard wood famine, which is sure to come *without* legislation. We are not aware of any material in practical use in the nature of metal that can be used for whiffletrees and tongues of mowers and reapers, for wheeled vehicles of any sort, for fork and shovel handles and for various other articles of general use, requiring strength as well as lightness. Aluminum may sometime be introduced for those and similar purposes, but it is bad economy to deliberately throw away a cheap material like wood for a more expensive one like aluminum, even if the latter could be made to serve the purpose.

Hichory, oak and ash are the only woods that can be used to construct safe wood machinery. The supply of these timbers is being rapidly exhausted by the thousands of acres annually used for manufacturing purposes. Many articles of furniture are made also from oak and ash which helps the slaughter very materially. However in that line, the quick growing and hardy maple is already forced in as a substitute, disguized and ornamented by stains and veneers. Machinery wood cannot thus be counterfeited. Nothing can be substituted for the slow growing hickory, ash and oak.

While people are left to gratify their tastes on Arbor Day by setting out those trees which they admire, not much will be accomplished by the philanthropists of Arbor Day that will serve as a practical benefit to our machinery makers. The good people usually have little taste for the slow and unshady hickory and oak or the unromantic and limbless ash. Laws which will make appropriations and establish government officials for the preservation and growth of a proportionate quantity of all timbers, would in a few years effect the supply in hard woods of the right strength for machinery purposes and thus save us great inconvenience in the near future.

At present there are no legal requirements in the direction of forestry in this country. Germany, England and other older nations have long found it necessary to see that future generations are supplied with some particular kind of wood. Our habit of destroying wood is inherited from our fathers who consumed their valuable timber at "logging bees" for the sole purpose of annexing territory to their vegetable and cereal domains. We must not only get out of this habit but we must also add to at least the hardwood portion of our forests.

There are thousands of acres of waste lands, not only in the Great American Desert of the West, but in the manufacturing districts of New England and the Middle and Western States, that might be utilized for the cultivation of just such timber as we need for mechanical uses. And we hope that either our secretary of agriculture will be authorized to require the planting of trees in these wastes, or that a Secretary of Forestry will be created for that specific purpose.

THE USE AND MISUSE OF PETROLEUM AS FUEL.

It is interesting and frequently amusing, to note the diversity of opinions regarding the value of crude petroleum for fuel purposes, as compared with coal or other solid forms of combustible. Generally these opinions are formed from experience or observation, more or less extensive, but they are not infrequently based on hearsay only, and that, too, with little or no knowledge of the subject on the part of the persons by whom they are expressed. These latter, of course, are hardly worthy of comment, but in reference to such as have actual practical reasons for their ideas, even though they may be in error as to the deductions, the subject is one which merits careful consideration. As the relative value of this fuel is purely a question of fact, and as facts never were, nor will be, either made or modified by opinions, however profound, it follows that the facts alone should be taken into account. We have accurate data as to the calorific values of all combustible elements, and the analyses of the fuels enable us to calculate the exact theoretical value of a given quantity and quality. With the single exception of natural gas, there is no form of fuel whose physical condition is so advantageous for either the necessary handling or for its combustion in the furnace. On the point of adaptability, therefore, it is safe to assume that the verdict would be unanimously in its favor. The only question, then, becomes one of a commercial nature—of dollars and cents.

Considered from the standpoint of economy, the two factors entering into the question are: 1. The market price of the oil, and, 2, the method of its utilization.

THE QUESTION OF PRICE.

As regards the first point, the fact that the price is a matter entirely with the producer places it beyond control of the consumer, and consequently, even with the most perfect method of its utilization, the cost may at any time reach a figure which will be practically prohibitory where economy is the consideration. And while there are occasionally cases where the other features of oil burning are more important than the cost, yet they are merely the exceptions, and economy is the great desideratum. Therefore, while the price which it is possible to pay and still be within the bounds of economy may and does vary considerably according to the degree of perfection attained in the handling and combustion of the oil, there is a limit which cannot be passed without sacrificing the main object of its use. What that limit is may be safely calculated, provided the relative costs of oil and coal be figured from the actual conditions on a uniform basis of work done by each. It is obviously misleading to consider only the cost respectively of oil and coal for a given time, and assume the results from their use to be the same. The latter quantity should be just as carefully and accurately ascertained as the item of outlay, and the cost can then be figured per unit of result. Of course the price of coal is the standard of value with which the comparison of costs must be made; and the commercial grade which, upon comparison of price with efficiency, shows the best results—not per ton, but per dollar—should be the one selected as such standard. By way of illustration we may assume the evaporative value of the grade of coal selected to be eight pounds water from and at 212° F. per pound of coal, and the price of such coal to be $3 per ton (including cost of putting into the bin). The number of heat units utilized would be 966 (the latent heat of vaporization) $\times 8$ pounds $= 7,728$. As the calorific value of such coal would be about 14,000 heat units per pound of coal, we find that there has been a total useful effect of $\frac{7,728}{14,000} =$ 55.2 per cent. only. The total quantity of water evaporated per ton of 2,000 pounds would be 16,000 pounds at a cost of $3 plus the wages of firemen and such other labor as was necessary. These incidental expenses must be taken into account in making the comparison, as they vary considerably according to the fuel used, and the larger the scale of operations the greater the variation of this item. As, however, the present illustration has to do only with the actual cost of the two fuels, the costs incidental to their use may be considered later on. If then the coal with a useful efficiency of 55.2 per cent. of its total heating capacity costs $3 to evaporate

16,000 pounds of water and we assume the same efficiency for oil, we can calculate exactly the cost of the required quantity of the latter fuel to produce the same evaporation, thereby establishing its comparative value on the price basis, after which the comparison of incidental costs may be considered. The calorific value of oil may be taken as about 20,475 heat units, and 55.2 per cent. of this amount will be 11,303 units, which divided by the coefficient of vaporization gives the number of pounds water which will be evaporated from and at 212° F. to be $\frac{11,303}{966} = 11.7$ pounds water per pound of oil, As a gallon of oil weighing 7.27 pounds (specific gravity 0.87) costs, say, 1.6 cents, then $3 ÷ 1.6 cents = 187.5 gallons is the equivalent in price of one ton of coal, as above, and as 187.5 gallons × 7.27 pounds per gallon = 1,363.125 pounds, then 1,363.125 × 11.7 (its evaporative value, as above) = 15,948.56 pounds water evaporated per $3 worth of oil. This showing, then, is that oil at 1.6 cents per gallon is practically equal in cost to coal at $3 per ton, both delivered at point of consumption, on the purely arbitrary assumption, however, that the possible useful efficiency of the oil as a percentage of its calorific value is no greater than that of the coal. Of course, it will be understood that great firing of the latter is alluded to in comparison, and that no reference is made to its conversion into fuel gas by the producer or other more recent processes. In order to estimate the aggregate of the several items entering into the incidental expense account, chargeable against the fuels respectively, it will be well to consider a steam plant on a moderately large scale, say, 1,000 horse-power, nominal rating—for ten hours per day. The qnantity of coal required, at 30 pounds water per horse-power per hour would be $\frac{30}{8} =$ 3.75 pounds coal per horse-power per hour, and 3.75 × 1,000 horse-power × 10 hours = 37,500 pounds per day, or 18¾ tons, costing $56.25. Say, the plant is composed of a battery of ten boilers of 100 horse-power each. There will be required not less than five firemen and one water tender, besides three laborers for wheeling coal and ashes. This refuse, amounting to about four tons, will have to be hauled by team in the majority of cases, at a cost of, say, 50 cents per ton. The above are the most important items, and are all that need be considered. We have then:

5 firemen, at $2 25 per day	$11.25	
1 water tender, at $2.50 per day	2.50	
3 laborers, at $1.75 per day	5.25	
4 tons ashes, at 50 cents per ton	2.00	
		$21.00
18¾ tons coal, at $3 per ton		56.25
Total cost of coal and labor per day for 1,000 horse-power		$77.25

Let us now ascertain the cost of the same duty by the use of oil fuel upon the basis of the same percentage of efficiency as used above. We have then $\frac{30}{11.7} = 2,564$ pounds oil per horse-power, and 2,564 × 1,000 horse-power × 10 hours = 25,640 pounds, or $\frac{25,640}{7.27} = 3,526.8$ gallons per day, costing, at 1.6 cents per gallons, $56.43, or within 18 cents of the cost of coal. But here the equality ceases, and it is in the matter of incidental expenses only that we must look for the economy, if any, to be gained by the use of oil. As it is used directly from the storage tank and handled by mechanical means, automatic in their operation, and as there is no hand firing to be done, and no ashes or refuse to remove, the only item in the expense schedule for coal which will apply on the oil account is that of one water tender at $2.50 per day. Of course the work of pumping the oil from storage tanks to burners requires the use of either steam or belt power, but it is so inconsiderable that it need not be taken into account as an item of expense, or it may be included as part of the total steam consumption necessary for the operation of the system. Whether compressed air or direct steam is used in the burners for vaporizing the oil, we may safely estimate this quantity at not over 2½ per cent. of the total evaporation of the boiler, and its cost would therefore be in the form of a percentage of the aggregate of all other items, to be added as the final item. We have then the following:

One water tender and first-class fireman, at $2.50 per day	$ 2 50
3,526 8 gallons oil, at 1.6 cents	56 43
Total	$58.93
Add 2¼ per cent. for steam used for burners, etc	$ 1.47
Total cost for oil and labor per day for 1,000 horse-power	60 40
Cost for coal firing, as above	77.25
Saving by use of oil is, therefore	$16.85
Or 21.81 per cent.	

This, however, is not the maximum possible saving; as the item of attendance charged against the 1,000 horse-power would not be increased for four times this duty—it is safe to say that one man can easily look after the burners and tend water for 4,000 horse-power, and still have very little to do in the way of actual work—the duty being one requiring watchfulness and care, and but little else. For coal firing, from the fact that the fire-room is necessarily more or less obstructed by the fuel, and by the firemen in working their fires, it would be impossible for one man to give proper supervision to fires, steam and water, and at least two would be necessary for this duty. The cost then for coal firing for 4,000 horse-power will be [($77.25—$2 50) × 4] + ($2.50 × 2) = $304, and for oil [($60.40 — $2.50) × 4)] + $2.50 = $234.10—the difference being $69.90, or 23 per cent. less for oil, as compared with 21.81 per cent. as in case of 1,000 horse-power. Of course such large plants are exceptional, and this illustration cannot be considered as applicable to ordinary practice. According to this showing, however, the advantage of economy is clearly in favor of oil, and if the assumed percentage of efficiency is notoverrating the facts, the deductions are correct. This point alone, then, is the crucial one in determining the comparative value of petroleum as fuel, and it becomes a question of the degree of perfection attained by the method of utilization—provided, of course, the relative price of the oil does not exceed the figure assumed in the foregoing calculations.

THE METHOD OF UTILIZATION.

To many—it might be said a majority of persons—the use of oil fuel resolves itself into a question as to which of the legion of so-called systems (which is simply another name for burners) is the best, and, that point decided, the value of oil fuel, and not of the burner, is decided by them according to the results obtained. Now, as a matter of fact, we might say that all of the many burners in the market are good burners—that is, they accomplish what is required of a burner, which is to vaporize the oil by means of a steam or compressed air jet, and thereby supply it in the proper condition for the initial combustion. But this is a very small part of what must be done in order to obtain the larger percentage of useful effect from the quantity of oil consumed. Almost any one of these burners, if supplemented by the proper means of continuing the combustion and utilizing the heat generated, is capable of giving the most satisfactory results—in other words, the problem is not one of the best burner, but of a properly-designed furnace. This question is one which, strangely enough, considering its importance, does not seem to have received the attention of furnace engineers—at least not in reference to its general application, although in some special cases the right kind of talent has been employed, and as a rule the results have been more or less satisfactory. As in all other branches of furnace engineering, a pretty thorough knowledge of the laws of combustion is necessary, as without it all attempts partake of the nature of guess work; and, even though the outcome of it may be an eminent success, it must be considered in the light of a fortunate accident, for the reason that it is manifestly impossible to lay plans when the requirements due to existing circumstances and conditions are unknown. In the present connection the problem involved is purely one of combustion as a cause and utilization as an effect. Let us now state it as tersely and explicitly as possible: Given a certain quantity of fuel of known chemical composition and physical condition, from the combustion of which to realize in useful effect the largest possible percentage of its theoretical calorific value.

A knowledge of the chemical constituents, as shown by analysis, enables us to calculate the exact heating power or calorific value, which we find to be, in the case of a Pennsylvania oil previously referred to, 20,475 heat units per pound. The physical condition is one of such extreme fluidity that when vaporized by means of an air or steam jet it becomes so finely subdivided as to resemble smoke. This is the quality *par excellence* which should enable us to effect the most perfect admixture of the combustible elements of the liquid with the necessary equivalent of atmospheric oxygen, to cause the initial combustion at the point of ignition and to make the completion of combustion to carbonic acid and water purely a matter of mechanical manipulation of the air supply. It would be well at this point to consider some instances of the misuse of oil—that is, not by reference to individual cases, but the kinds of misuse which are so common as to become the rule rather than the exception. First is the case of one or more burners placed in the fire doors of an ordinary boiler front, the grate being covered with fire-brick or some other protective material. With an unlimited air admission from the ash pit, without any attempt at regulation, the necessity for any more careful air supply is not realized, owing to the fact that the smoke stack shows no smoke, and there must, therefore, be perfect combustion of the oil (?). The inference, as a matter of course, is that the burner (or "system," as it is usually styled) is a good one. This may be considered one of the most crude, wasteful and destructive of all methods of oil burning, as can be readily understood by noting carefully the volume and quality of the flame and the consumption of oil in proportion to the duty performed. Upon looking into the furnace through any convenient peep hole which will not permit the passage of a sufficient quantity of air to affect the character of the flame (and a surprisingly small amount will do this) the most noticeable feature observed will be the brilliant whiteness and great intensity of the entire mass of flame, almost from the very nozzle of the burner—also its high velocity. Generally, too, the flame will be found to impinge directly against the bottom of the boiler, above the bridge wall. It will also be noted that the mass of incandescent brick-work in the boiler setting is comparatively quite small, though of high intensity. It is confined almost entirely to the portion of the furnace near the bridge wall, and extends but a very short distance beyond the latter, as, while it is not always possible to notice the length of flame, it will generally be found very short, and the effect of the combustion is practically confined to the limit of its extent.—[Iron Age.

(To be continued.)

Motors in Collieries.

Some doubts are entertained as to the desirability of employing electric motors in collieries. One of the objections which have been raised is the possibility of gasexplosion being caused by a spark occurring at the commutator of the motor where the electric current is conveyed into and out of the rotating armature by means of the brushes; another objection is the use in the pit of driving belts, which not only take up space, but cannot be kept in good working order in dirty and damp situations. In regard to the commutator difficulty, it is admitted by experts that, in many dynamos, bright bluish sparks may be occasionally observed at the tips of the brushes, especially if the latter are not in proper adjustment; in well-designed machines the spark is practically non-existent under ordinary conditions of working; it is so close to a large mass of copper that it is practically cool—so cool, indeed, that it is very difficult to cause it to ignite anything.—[Cleveland World.

THE new rolling mill at Ironton, Minn., a suburb of Duluth, will cost about a quarter of a million dollars.

LAUNCHING OF WHALEBACK BARGES.

Some time last winter the Soo Ste. Marie Railway ordered, of the Steel Barge Company at W. Superior, two large whaleback steamers, to run between its Lake Michigan terminus and its Canadian Pacific connections on Owen Sound in Ontario. The vessels were to be larger than any theretofore built by the whaleback people, and were to be completed by July 1st. On June 25 both steamships were launched, in as nearly a completed form as possible, there remaining but a few finishing touches to add to equip them for their carrying career. The boats have been named after the fathers of the Soo road, Pillsbury and Washburne, gentlemen whose milling interests are expected to provide a large share of the carrying business of the steamers. The third steel craft was a tug of 60 feet in length.

The *Pillsbury* and *Washburne* are duplicates of each other, and are 320 feet long, 42 feet beam and 25 feet moulded depth, with a registered net measurement of 1,572 tons. Either of them will carry 3,500 tons on full draught, or 28,000 barrels of flour from Gladstone to Georgian Bay ports. They will probably outcarry any other vessels now plying on the lakes, although the Maritana, of the Mather line, and the Pathfinder will top them a trifle.

At the hour set by the barge Company people the Pillsbury was put over the greased timbers amid the cheers of the crowd, the waving of handkerchiefs and the shouting of stern whistles. Within half an hour the Washburne followed suit in the same manner, and shortly after the tug went also, completing what was probably the first tripple launching of three steel steamers in one yard that ever took place in this country. There is thus added to the whaleback fleet on the great lakes two steel steamers, which brings the total carrying capacity of this class of vessels now in service on fresh water to something over 50,000 tons, being 12 tow barges and 8 steamers. If the 12 barges were put in tow of the 8 steamers, they could bring from Buffalo to Superior in five days 46,000 tons of hard coal, and in a season might carry 600,000 tons, or half the total receipts of all kinds of coal at Superior docks.

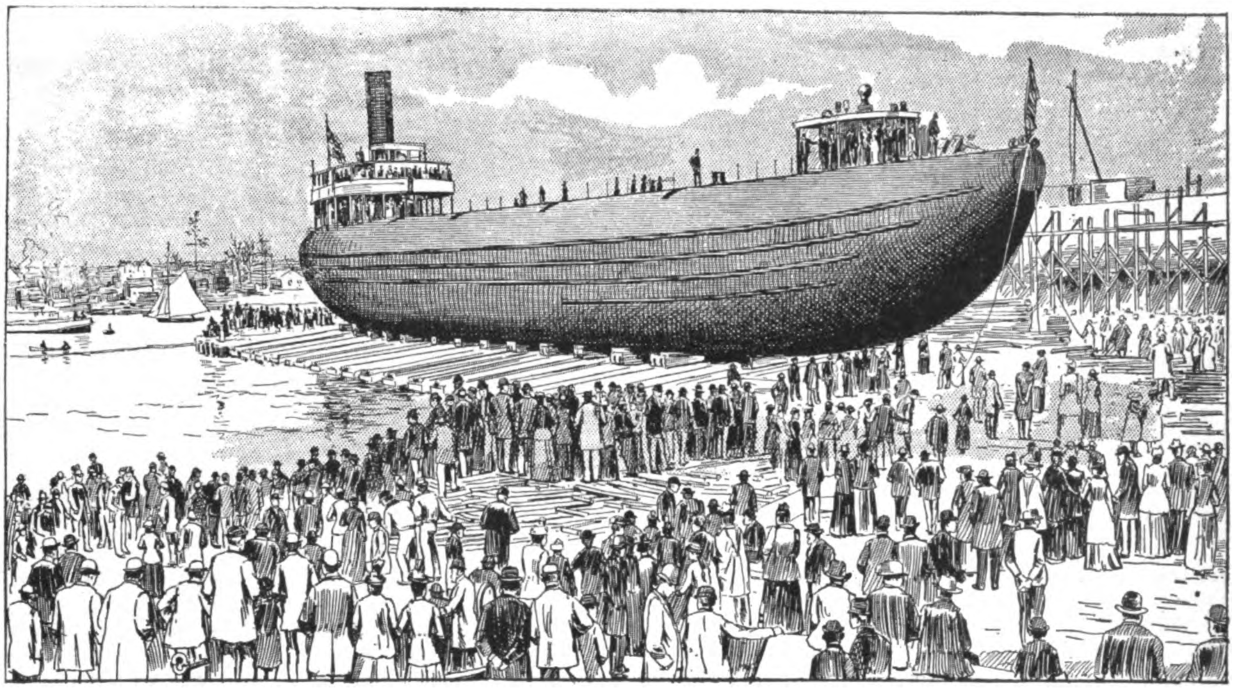


FIG. 1.—LAUNCHING OF THE "PILLSBURY."

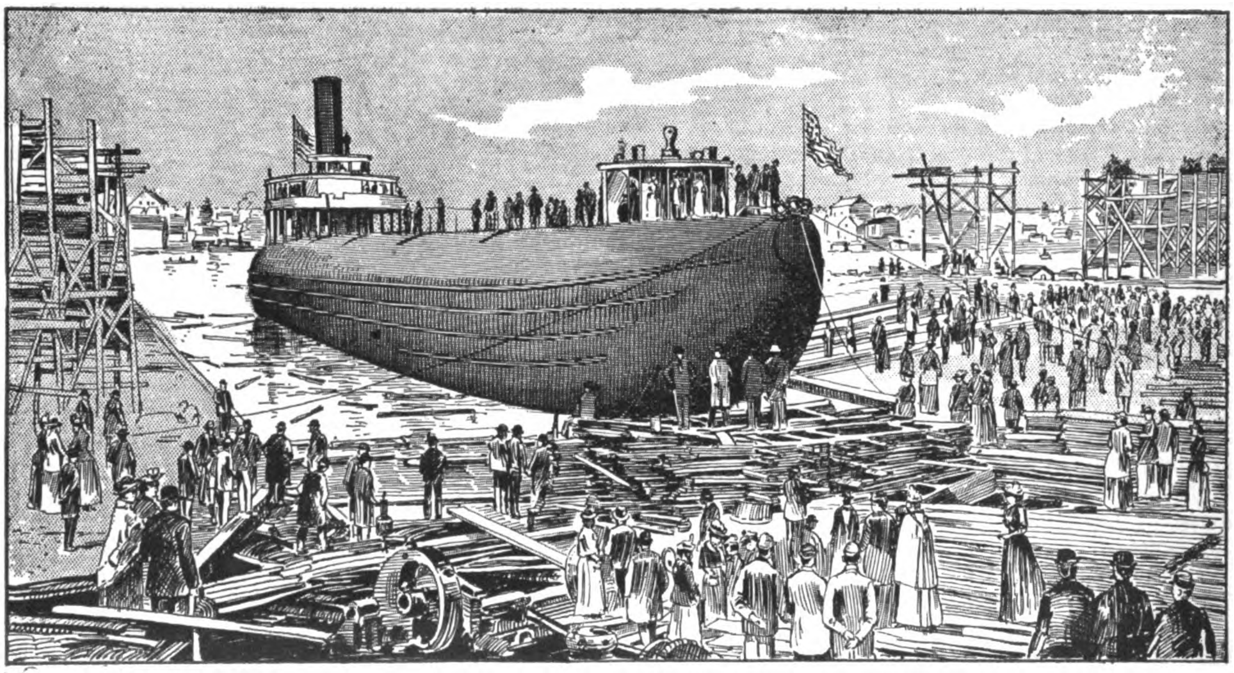


FIG. 2.—LAUNCHING OF THE "PILLSBURY."

Corn Harvester Trust.

The organization of the American Corn Harvester trust, to embrace all the leading manufacturers of corn harvesters in the country, has been effected. The association embraces the McDonald Manufacturing Co., of Bellefontaine, the William N. Whiteley Co., the Foos Manufacturing Co., and the Springfield (O.) Implement Co. The officers are: president, H. M. McDonald, of Bellefontaine; vice-president, G. S. Foos, and secretary and treasurer, H. S. Bradley, both of Springfield, O. The association has purchased the Peterson patent, on which all such machines are based. Its object is to secure more uniform prices to dealers and protect all from infringement suits. The headquarters will be in Springfield, O., but the officers refuse to state the amount of the capital of the association.

PATTERN MAKERS CONTRASTED.

BY JOHN M. RICHARDSON.

Workmen in almost all trades can be separated into two classes, and pattern makers are no exception to this rule, for everywhere we find on one hand the careless workman and on the other the ambitious man who looks ahead.

The indifferent pattern maker still abounds and seems to have no ambition at all, or rather none except one which is all absorbing and has for its goal six o'clock and pay day.

For the sake of contrast let us first look at the distinguishing features of this individual. He is usually discontented; a "kicker," as we say, and constantly laments his misfortune in ever having taken up the trade, claiming it is getting worse and worse every year, and comparing it now with what he seems to believe it was in days gone by. He never expects, however, to command more than the average rate of wages, but at the same time is unmindful of the fact that he is a member of a class which can never hope to see the standard raised, owing to the fact that they never bend their energies to endeavor to become masters of their trade.

The indifferent man takes but little interest in either the quality or quantity of his tools. He can't tell for the life of him how his fellow workman at the same bench, who has a large and carefully selected kit besides having a family to support, can possibly afford to keep up with the times and buy so many newly-patented tools.

In getting out stock to glue upon a big job he saws and planes up all the lumber, fits the hand clamps, and is just ready for the glue, when he happens to think he forgot to mix up a new lot and get it to cooking.

When a chuck or face plate gets stuck on the spindle, as it occasionally will, he grabs a hammer or else a monkey wrench and bangs away, seemingly oblivious to the fact that he is mutilating what belongs to another.

In altering over an old pattern he is about sure to run into a nail on some of the machine tools, and thanks his stars that it wasn't one of his own tools which received the blunt edge or gap, for now the boss or else some man who has it for his part will do the sharpening. He does not think it desirable to at least learn the theory of the best forms of different saw teeth and cutters for he never expects to have them to keep in order. Such characteristics might be extended indefinitely if time and space would allow.

The ambitious man on the other hand desires to succeed and realizes that success, if it comes at all, must come through his own efforts and a careful attention to details. There is no royal road to pattern making. No one stands ready to push a person who has no aim or desire.

This reminds me of the following which I once saw in print and which contains more real food for reflection than many longer poems can ever hope to lay claim to:

"The man who is too devoid of aim
To make the least advance,
Is sure to be the first to claim
He never had a chance."

The wide-awake man will think first and act afterwards. His glue is ready when his stock is. His tools are sharp and he knows where to lay his hands on them. He constructs his pattern in the best manner for the purpose it is to fulfill, and can explain the why and wherefore of so doing, and is in a word self reliant. Furthermore, he tries to keep abreast of the times in regard to the best pattern shop practice in every way he can, such as carefully reading a good trade paper, visiting other shops whenever the opportunity offers, sending for catalogues of the best tools and appliances of interest to him, and asking questions about every point of which he is in doubt, and finally from all information received, "sifting the wheat from the chaff."

I will now mention a few points which may at least prove helpful to the young pattern maker.

First remember it is paying attention to little things that tells in this rade as well as any other.

Do not be misled when the indifferent workman tells you it is all bosh o take pains and finish up a pattern carefully, and that just as good castngs are obtained by the use of rough patterns as by good ones, and that care in varnishing is simply a waste of time. It is true that nice castings can be produced by the use of coarse and poorly constructed and varnished patterns, by the molder taking extra time and pains, which on the other hand would be unnecessary, but the point comes just here. Any one can urn out a coarse rough job in a short space of time, but it is not every workman by any means who can make fine, accurate and nicely finished patterns, put together in the best possible manner, no matter how long a ime he spends on them, and the man who can do this class of work will have an easier time and receive more pay than will the careless workman n almost every instance.

Filling nail holes with bees-wax, and mixing and applying shellac varnish may seem very easy to many, but for all that it takes care and pracice to force in the wax in a neat manner so that after a pattern has been varnished and held in the right light it will not show a slight cavity or else a raised daub to act as tell-tale for the nail hole, and also to lay the varnish o that it will show an even surface and in addition not have a surplus laid along in ridges on the edges and parting line.

In mixing black shellac first stir the lampblack and alcohol together ill they are of the consistency of cream and free from all lumps, before addng the yellow shellac, and then stir the whole mixture thoroughly together.

A yard of cheese cloth costs but five cents, and if cut up into squares nakes an excellent strainer, using only a piece at a time and then throwng it away. It is better to do the mixing in a different vessel than the one used to varnish from, such as an old tin pail, etc., then strain through the cloth into the regular pot from which the brush is used. Shellac carefully mixed and applied makes a wonderful difference in the appearance of a completed pattern in contrast to one carelessly finished, and at the same time adds to the workman's reputation.

The secret of rounding corners on patterns whether they are large or small consists in having them so that one can see neither beginning nor ending to the curve; that is, have the curve a true arc and avoid having it show a line where it comes tangent to any straight side. To do this well requires care and practice, but one feels repaid for it when the pattern is inished, and besides a poorly rounded corner is one trade-mark of careess work.

A Monster Ship.

The largest merchant vessel ever built in an American shipyard was aunched last week by the Newport News Shipbuilding Co., says the Detroit *Free Press*.

El Norte is constructed of iron and is of 4,500 tons register. Her dimensions are 380 feet from stern to stern post, 406 feet over all, 48 feet beam and 33.9 feet depth. She has three decks and a partial or top deck at the fore end of the forehold. She will be rigged with four iron pole nasts and the necessary booms for handling cargo, and will have steam hoisting machines at the different hatches. The vessel will be steered by steam from the forward pilot house, or by a screw-head gear from the after house. There will be a steam windlass and steam capstan for handling anchors and hawsers, and a steel rope for towing.

The ship will be propelled by a vertical triple expansion engine. The cylinders are 32", 52" and 84" in diameter, with 54" stroke of piston. Steam will be generated in three double ended cylindrical boilers. There will be wo fire rooms and one smoke stack. Up to this time the largest ship ever launched in this country was the steel cruiser New York, which slid rom the ways at the Cramps shipyard last November. The dimensions of he New York, which is the largest cruiser of our navy, are: Length, 350 eet; breadth, 34 feet; draught, 23 feet.

Largest Cannon Ever Constructed.

Krupp, of Germany, will exhibit at the World's Fair the largest cannon ever constructed, weighing 122 tons. A. Lauter and G. Gilhausen, ngineers, reached Chicago last week to make arrangements to install the big gun. It required the Emperor's invitation, which was equivalent to an order, to induce him to make the exhibit.

"We have had great difficulty," said Herr Lauter, "in making provisions for unloading the cannon and transporting it to Chicago. In the first place, there isn't a derrick in America sufficiently strong to hoist the gun from the ship. In the second place, the railroads and railroad bridges between Chicago and New York are not entirely adequate to carry such a load. The special car on which the cannon will be shipped will itself weigh nearly 20 tons, so that almost 142 tons will be comprised in the ingle load, the strain of which will have to be sustained by the railroad bridges. The Pennsylvania company say they can handle the car and gun. But every mile of track and every bridge over which this immense load must pass will have to be inspected before we can feel certain that he exhibit will be safely landed in Chicago.

Practical Letters.

The Numbering on Rules and Squares.

EDITOR SCIENTIFIC MACHINIST:

A friend was telling me a few days ago that English steel rules and squares are numbered from right to left. I never saw an American tool of this kind numbered any other way than from left to right. I think the reason for numbering this way is that such a tool, when held up before one's face for setting calipers, is much more handy than one of English make, for the former will enable the mechanic to measure the way everything (in this country at least) reads, from left to right, while the latter will compel him to measure and read the figures backward. If any reader of this paper knows any other reason, would be pleased to hear from him.

JOHN BLACKHORN.

How the Difficulty was Overcome.

EDITOR SCIENTIFIC MACHINIST:

In regard to question 378 in issue of 15th inst., "A. D. J." does not say in what way he takes steam from his two boilers. Now, some years ago, to give us more power, we put in a second engine attached to the opposite end of the engine shaft, making a double engine, also another boiler side by side, and took steam from a cross pipe with a tee midway between the boilers, and fed into a mud drum connecting both boilers. With unequal firing and with the new boiler making steam easier than the old one, the extra pressure would force all the water out of the new boiler until the other was quite full. We put a very large independent steam connection between the boilers and our trouble in that line was at an end.

Let the steam have full access from one boiler to the other, and the pressure being equal the water will be level. JAMES TAIT.

Those Gauge Testers.

EDITOR SCIENTIFIC MACHINIST:

It was not my intention to write any further in regard to this subject, but Mr. "J. L. H." has in your issue of June 1, made it my duty to do so. I now see plainly that I have made an error in criticising Mr. Woodward's seven papers, and hope he will pardon me for it. It also affords me pleasure to say that Mr. W. has written many interesting and valuable papers, and I have no doubt he would be a good fellow to let alone in an argument. However, I cannot see any reason why I should change my views in respect to the gauge tester he recommended.

Allow me to thank "J. L. H." for calling my attention to the error I have acknowledged above, and for "taking me at my word." I have never lost by having my work criticised. On the contrary I have often gained thereby.

Since receiving my copy of the SCIENTIFIC MACHINIST of June 1, I have had a pattern made for the tester I have described in these columns, and before the letter can appear I shall have some completed and will know what they cost. I do not intend they shall cost the purchaser over $5 for those black finished. If they are not accurate and in all ways satisfactory, they may be returned at my expense. Any letter addressed to me in care of the editor of SCIENTIFIC MACHINIST, will receive prompt attention.

It was in solving just such a question as E. A. Collins asks (question 374) that brought the gauge tester to my notice. This is the way it happened: About eight years ago Boiler Inspector A. C. Getchell was notified that some steam gauges he had tested were not correct. He asked me to accompany him on this trip and I did so. He took his little hydraulic tester with him, but before using it he had already defined the trouble. One gauge was connected by a straight vertical pipe, allowing the steam access to the bent tube spring, which is ruinous to gauges of this kind. The other gauge had a syphon connection and was affected only by pressure while the other had to contend also with the element of heat.

M. C. MAC.

The Corliss vs. the Slide Valve Engine.

EDITOR SCIENTIFIC MACHINIST:

In your issue for July 15, I notice that Mr. Adams, the leading man in the "Set of Fine Tools" narrative, now running in your paper, gives Joe Miller a lesson in Corliss and slide valve engines. It is very well done. Now, I want to give you the explanation of the difference between these two kinds of machines in the way that an old engineer I know, who also knows no algebra nor theory, but only common arithmetic and common sense, would have given it to Joe Miller. His way of figuring is new, and quite interesting. I know no reason why it should not be entirely correct. Assuming that he is in Mr. Adam's place, he explains it as follows:

The cylinder of our engine is 14"x24", and makes 190 revolutions per minute. Now, it cuts off at half stroke, and, consequently one-half of the cylinder must be filled full twice at every revolution. Supposing this cylinder (pointing to the slide valve model) to be 14"x24", the volume of steam, in cubic inches, that is required to fill each end will be as follows: The cylinder being 24" long, 12" of space must be filled twice at each revolution. Now, the number of square inches of surface in a piston 14" in diameter is 153.938, so this, multiplied by 12, will give the cubic inches in one-half of the cylinder. Just multiply and get the result. 1,847.256—correct. This space is filled twice with each revolution, so we multiply the number of revolution per minute by 2 to find it. 190×2=380—correct. Now, the cubic inches in half the cylinder, multiplied by the number of times it is filled per minute, will give the cubic inches of steam necessary to run the engine one minute. Figure it up, now. It is, as we see, 701,957.28 cubic inches. This is a high speed side valve engine.

The Corliss engine is producing the same power in one minute as the slide valve, and we will proceed the same with that. This cylinder is 18"x42", and makes 75 revolutions per minute. It cuts off a ¼ stroke, so that 10½" of the cylinder must be filled twice with each revolution. The area of an 18" piston is 254.469. The number of cubic inches in ¼ of the cylinder is 2,671.9245, if your figures are right—and I believe they are. Now, the engine makes 75 revolutions per minute, and this ¼ space is filled twice each revolution, or 150 times. We see by multiplying 2,671.9245 by 150 that 400,788.675 cubic inches of steam are required to run this engine one minute. It required 701,957.28 cubic inches to run the slide valve one minute, so we see that the number of cubic inches that the slide valve requires more than the Corliss, is 301,168.61". This makes a great saving in coal. But remember that this is not absolutely correct. Perhaps it may be denied outright by some.

The difference is, that in the Corliss cylinder the steam is cut off sooner than in the slide valve, and the rest is done by expansion. Why don't we get a Corliss? Well, the reason why the slide valve is used by some instead of a Corliss is because the Corliss costs more. It has four valves, as you see by this model, and the engine and consequently the cylinder is larger. The extra valves make more machine work, to which must be added the fixtures or valve gear, and the more particular work necessary on a Corliss. Our slide valve engine cost $1,800, and the Corliss in the Reynolds' mill probably cost $2,500. I have told you nothing about cards nor pressure, and at some subsequent time, when you have gotten further along in practice, I will give you other lessons.

J. J. H., Akron, O.

Those two Boilers Again.

EDITOR SCIENTIFIC MACHINIST:

In reading over your "Questions and Answers" I see what Mr. Wilcox says in regard to "A. D. J's" two boilers. I do not think his plan will help the trouble much; if he brings the centers of each boiler to the line he will drown the small boiler, if he gets enough water in the large one. Now, my plan is to draw the water line on each boiler, then level by that and he will have no more trouble, but the cheaper way would be to disconnect the boilers at the bottom and feed separately. A. M. GLIDDEN.

EDITOR SCIENTIFIC MACHINIST:

More About the Boilers of A. D. J.

Your valuable paper came to hand yesterday, and I noticed in a "Practical Letter," on the two boilers of "A. D. J.," by Frank Wilson, that he says, draw a line through the center of each boilers and bring the boilers to a line. He evidently mis-speaks, for the *water lines must be level*, or the water cannot be kept even in the boilers with any satisfaction at all. Valves in the connection might do it, but would be a nuisance.

W. D. J. EVERETT.

Suggestions for A. D. J.

EDITOR SCIENTIFIC MACHINIST:

Acting on your invitation to discuss the connections of "A. D. J.'s" boiler, I beg to submit the thoughts I had, when reading the concerning articles:

1. If the small boiler acts as a condenser, it is of no use to fire her? Try the big one alone, or if the grate allows it, change the fuel.

2. If there is no separate stop and separate check-valve on each boiler, I would earnestly advise to change the feed connections. I don't believe in F. W.'s free water circulation between boilers. As I found it, every boiler has her individual water level, at which she will do her best, the height often varying under different pressures.

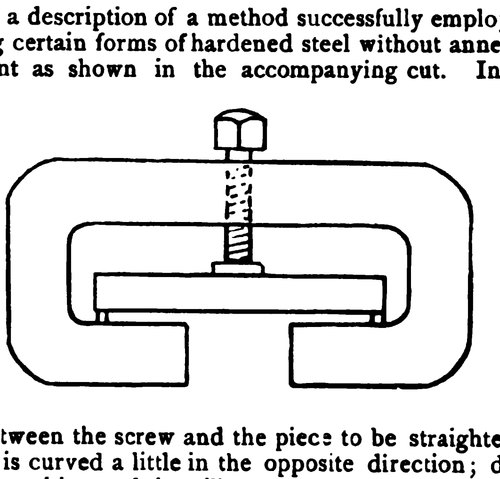
3. Please let us know the size of engine, length and general connections of steam-pipes. To have a 2½" steam-pipe on this size of boilers seems at least curious.

4. Very probably the situation of the engine allows all water of condensation, etc., to be drained back to boilers with little or no loss of heat. I would not go to the expense of re-setting an engine for the cause mentioned. H. HEYRODT, Chief Engineer.

Straightening Hardened Steel Without Annealing.

EDITOR SCIENTIFIC MACHINIST:

I give here a description of a method successfully employed by myself for straightening certain forms of hardened steel without annealing. Have a bar of iron bent as shown in the accompanying cut. Insert a narrow plate of iron between the screw and the piece to be straightened, press it carefully until it is curved a little in the opposite direction; draw the temper while in this position and it will come out straight. If they are not bent too much, punches, dies, reamers and many other tools can be straightened by this device, without annealing. "KINKS."



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To the West via the Nickel Plate.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(406.) A. R. S., Port Huron, Mich, writes: "My boiler foams, or primes, and I cannot tell what is the matter, nor can I prevent it. I would like to have you tell me how it is done, how to find the water level, and also to stop the foaming without stopping the engine." *A*—There are a good many different causes of foaming, and a knowledge of the conditions is essential to the rendering of an opinion. Generally the foaming can be stopped by deadening the fires, i. e., renewing fuel and shutting the furnace doors, blowing off and giving the boiler some cold water. The water level can be found when the foaming has ceased. By this treatment it is not necessary to shut off steam and stop the engine. We have known engineers to cause the foaming to subside by shutting off the steam suddenly and turning it on again so quickly that the engine was not stopped. It should not be fully opened at first, but turned on slowly, but great care should be exercised in doing this. If it is the rising of water in the boiler owing to the over-consumption of steam, it should not be called foaming. This can be prevented in no other way than to draw less steam or to make more—if the latter is possible.

(407.) H. G. & Co., ——, Pa., ask: "Why are belts run slack?" *A.*—Generally to give the pulley more surface of contact with the belt, causing it to pull better.

(408.) W. B. Woodhill, Laredo, Texas, writes: "I have in my charge, as engineer for this company, six Edison dynamos, four No. 12, and two No. 8, which are driven by three Ball engines, two of 100 h. p., and one of 50 h. p. One set of No. 12 and No. 8 are used every night, the other No. 12's being used as a relay in case of accident. Can you tell me why one pair of No. 12 dynamos which we will call 1 and 2 blue, drawn by the same kind of engine at same speed and connected to the same circuit, should pull 50 amperes more than another pair of the same kind which we will call 1 and 2 red? On the 1 and 2 red, my belts run quite slack, but on 1 and 2 blue they are drawn as tight as the dynamo boxes will allow, without burning up, and even at that tension they slip, which causes a flicker in the lights. Your valuable paper arrived yesterday and, as usual, very much appreciated. By answering my question you will greatly oblige. I had an argument about where to put feed water into a boiler, and it was answered in my favor in your questions and answers column of this date." *A.*—If the pulleys on the dynamos and shaft are the same, there should be no such difference. We could not suggest the cause, but if the conditions are alike in every respect, as above stated, the trouble will probably be found where it is least expected. A very small and unlooked for thing often causes great trouble and loss. Careful and continued search should locate it.

(409.) W. M. B., Pratt, Minn., writes: "Will you please inform me in the next issue of your valuable paper as follows: Suppose figures 1, 2, 3 and 4 represent four vessels filled with water. (They are, or may be called, ten feet high. The area of the bottom is the same on all. 1 is the same area at the top as at the bottom; 2 is about three times the area at the top as at the bottom; 3 is about one-fifth the area at the top as at the bottom, and 4 is essentially the same as 3.–ed). The diameter across the bottom is two feet and the water stands at the same height in all of them. Although the amount of water in each of them is different, why is the pressure at the bottom equal?" *A.*—The pressure is not equal in all parts at the bottom, nor is there the same total pressure in all of them. The pressure at the bottom depends upon the height of water directly above it, that is, perpendicular to the bottom at all points. In 1 and 2 the pressure per square inch at the bottom would be equal at all points. But in 3 and 4 it would not, since there is not an equal height of water perpendicular to every square inch in the bottom of each.

(410.) J. W. Terry, Amanda, O., asks: 1. "Will you please tell me where the *Mechanical News* is published?" *A.*—110 Liberty street, New York City. 2. "Is the pressure per square inch the same on the valve as it is in the boiler on a slide valve engine?" *A.*—Not always. In some engines the wire drawing reduces the pressure on the valve below that on the boiler.

(411.) W. M., Pomeroy, O., asks: "Please give me a correct way for staying a boiler, that is, for finding how many stays a boiler of a certain diameter requires, both cylinder and flue boiler. How much strain is allowed on a wrought iron stay? If the safe working pressure of a boiler is 150 pounds, will it take 900 pounds to explode the boiler with the water at its proper level?" *A.*—The United States government allows 6,000 pounds to one square inch of stay, therefore multiply the area of surface to be stayed by the steam pressure, and divide by 6,000. The bursting pressure of a boiler is the safe working pressure multiplied by 6 as a factor of safety, multiplied by the radius of the boiler in inches.

(412.) E. D., of Cleveland, O., wants to know of some liquid or preparation that will keep a boiler clean without injury to it. *A.*—There is no safe preparation that will cleanse a boiler without considerable work and care of the boiler. Kerosene oil, catechu and soda potash are good. Malt sprouts have been used with considerable success.

THE whaleback Pathfinder was launched at the Barge Works at Superior, Wis. July 16. It is the largest whaleback yet made, measuring 340 feet in length with a burden of 4,000 tons.

INTUITION IN MACHINE DESIGNING.

There is no part of the extended field of mechanical engineering which calls for the exercise of mechanical intuition and inventive capacity to such an extent as machine designing. There is scarcely a machine of any kind conceivable that may not be designed in such a great variety of ways that it may perform its functions or subserve its purpose more or less perfectly; while its efficiency, cost, durability and fitness in every way will be as various as these possible designs. It is the most intuitional mechanic that will evolve the best design in a vast majority of cases rather than the man who is expert in the higher analysis, says J. J. Hawkins in *Engineering Magazine*, and there are few experienced mechanical engineers who are competent machine designers who will not bear me out in saying that a very large proportion of machines never require the aid of a calculus to give them their best and most efficient design and proportions, and that the application of that powerful instrument could not be of much, if any, effect, in bringing them as near as possible to perfection.

Machine designing forms so important and extended a part of the profession that what would seem to be most needed in mechanical engineering schools is a more definitely marked out course in that particular branch. The course in mechanical drawing, now constituting a definite part of the curriculum, should, of course, be an adjunct of this branch—and a principal one—but only an adjunct; while what should really be prominently a course in machine designing should include in a more or less extended way what the name implies. In such a course, machines and parts of machines should really be designed, and the same part or machine be designed in various competitive ways.

There is, of course, no end to the extent to which this might be carried, quite to the detriment of the boy's more fundamental and general instruction; but exactly the other extreme is now pursued in paying too little attention or giving an insufficient prominence to the development of the mechanician and in consuming too great a proportion of his college period in refinements of the more general studies which he can very much better dispense with at the outsets of his career in practical life, and more easily acquire afterwards than he can do without that which calls for the exercise of his executive and constructive capacity at the start.

The present system leaves the man at graduationas an " M. E." in such position that, in the majority of his possible fields of activity, little is to be hoped for from him in earning capacity (and for a large number of our young men this is a very serious matter), and is dooming many promising young men, really capable of better things and deserving of better prospects, to a long period of subaltern drudgery, with disappointments, and discourages them to the last degree.

The kinematics of machines, as given in the text-books now in use in the schools, constitutes a valuable branch of general study in the direction of development of mechanical intuition, but this kind of study of mechanical movements is too general in character to operate definitely in the direction of educating the inventive or mechanical bent, unaided by the more specific study of and exercise in constructive problems.

Shop practice and instruction as now pursued is of the last importance; but it takes hold of the problem at the extreme practical end only. It imparts an indispensable kind of instruction, to be acquired in no other way so well, and one which no mechanical engineering student should have less of than he now obtains at those institutions; but between this and text-books kinematics—as particularly pertinent to machine designing—lies the missing link which is wanting in the undergraduate courses.

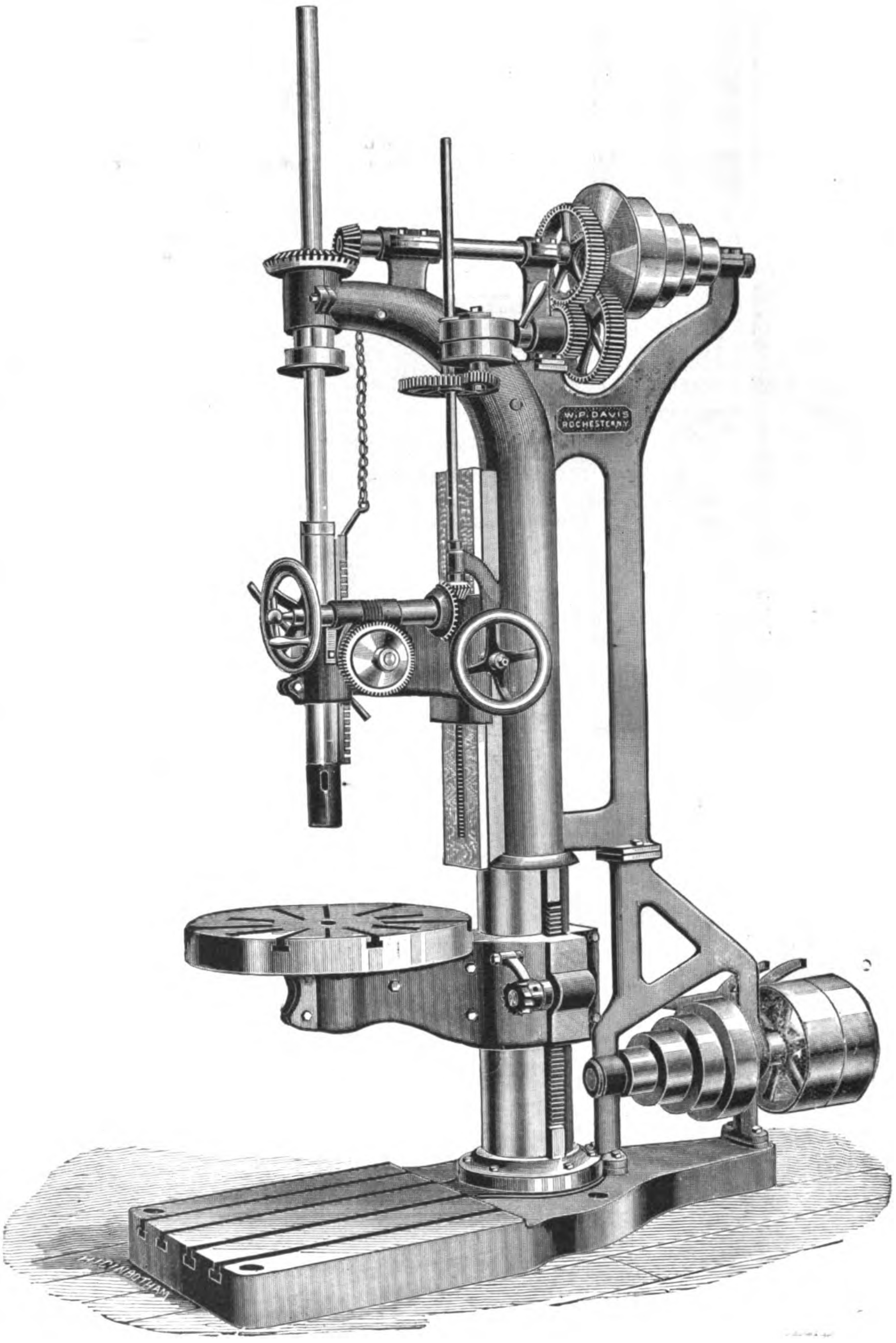
The study of kinematics as now taught is essential in the course as either of the other fundamental branches, and shop practice, within the limits of the school period—while far from making a skilled mechanic of a man—teaches him how the principal operations in the shop are best performed; but a proficiency in both of these, added to the various fundamental parts of his general curriculum, still leaves him—particularly as a machine designer and executive engineer—without the ability to play such a part therein as should reasonably be looked for in a graduate. It should be a part of his curriculum to design some machines, and invent others, in a competitive manner, such as might be expected to properly subserve some predetermined purpose.

NEW 32 INCH DAVIS DRILL.

The cut as shown is of a 32" drill but recently brought out by W. P. Davis, Rochester, N. Y. By a glance at the cut it will be readily seen that this drill is well proportioned and has great strength for the material used in its construction.

The spindle of this drill has an unusually long travel in the head, it has a vertical travel of 16" without moving the head. It drills to the center of 32", the spindle is fitted to Morse taper No. 4, the driving pulleys are 14" diameter and 4" face. This drill is well and accurately made and is intended for heavy, rigid work. Great care is taken in finishing these drills as to accuracy of the spindle with relation to the face plates and the base plates. All gears and racks are cut from the solid metal. The feed rack and pinions are cut from bar steel and the drill is made throughout in first class manner.

For full particulars write to the manufacturer.



NEW 32-INCH DAVIS DRILL.

Largest English Ship.

The biggest English sailing ship afloat—the largest vessel of its kind ever to enter the Golden Gate—rides at anchor in the stream. The Liverpool is 333 feet long, 47½ beam and 27½ deep. She is comparatively a new ship, having been built at port Glasgow, on the Clyde, in 1889. She has four masts, is square-rigged through out, and when under plain sail carries no less than 10.000 yards of canvas. She is built of steel, with an iron main deck and iron between decks. Her masts and all her lower sparsare of iron with a steel topmast and her anchors weigh more than two tons each. It is said that the French ship La France is the only sailing vessel afloat that is larger than the Liverpool. Until the arrival here of the Liverpool the largest sailing ship to enter this port was the Palgrave. She registers 3,078 tons, is 322 feet 5 inches long, 49 feet 2 inches beam and has a depth of 25 feet 4 inches.—[San Francisco Examiner.

Coating Iron.

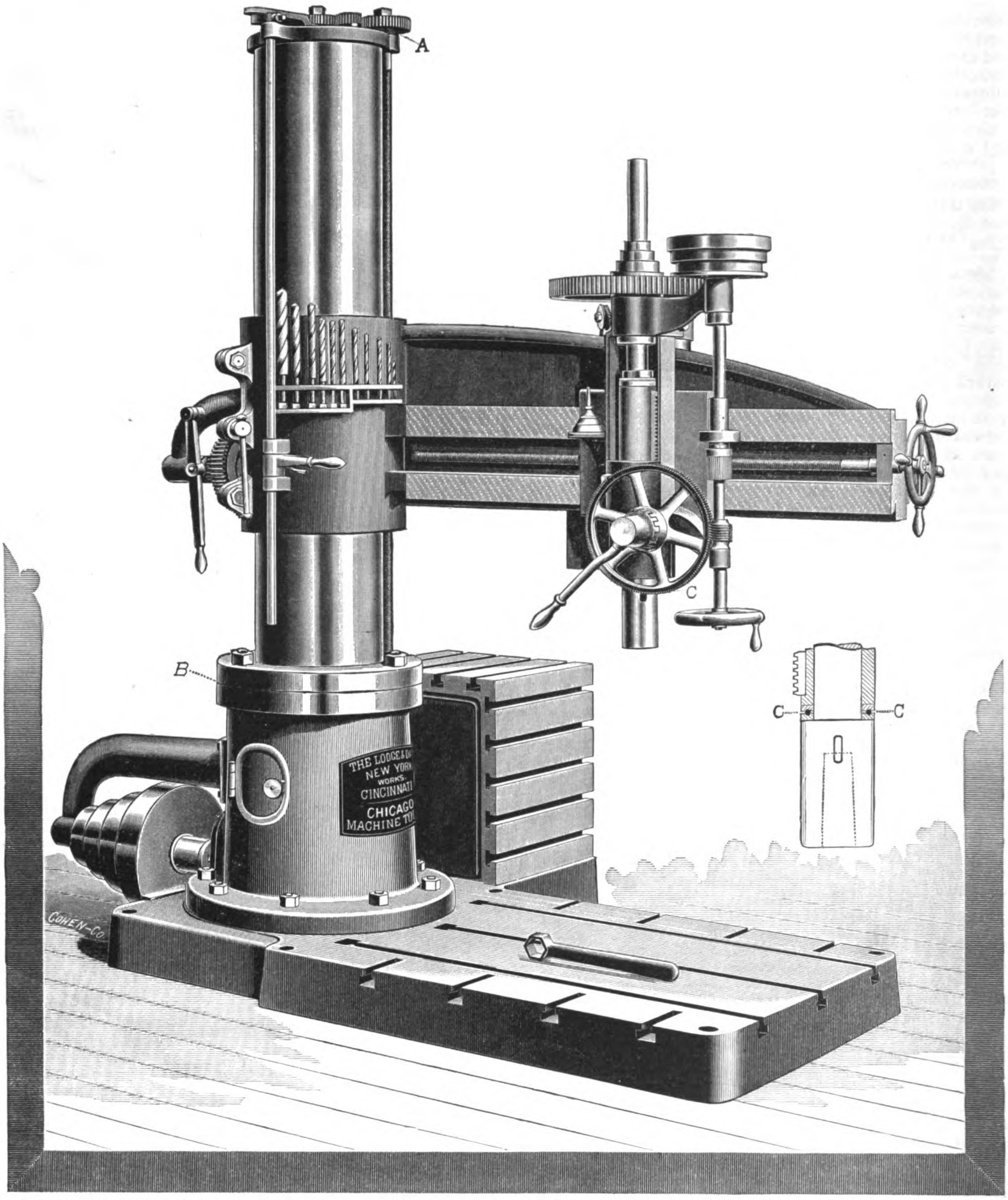
A process of coating iron with lead on zinc has been introduced at the Westwood works, Millwall, England. It consists of first pickling the iron articles to be coated with lead in a weak acid bath, through which a mild current of electricity is passed; this loosens the magnetic oxide or scale and cleans the iron, the latter being next placed in a lime water bath, by which the acid is neutralized. The iron is then washed in a bath of clear water, all three baths having a temperature of 120 degrees Fahrenheit. The next step is that of immersing the iron goods in a liquid metallic bath, composed of zinc and tin in equal parts, in a solution of hydrochloric acid, at a temperature of 110 degrees. The iron is subseqeently passed through a bath of molten lead in the same way as in the ordinary galvanizing process, and this gives it the desired lead coating.

Great Reduction In Rates.

To Denver, Col., Helena, Mont., Ogden and Salt Lake City, Utah. Ask Nickel Plate Agents.

IMPROVED 5 AND 6 FOOT ARM RADIAL DRILL.

On this page, we illustrate a front view of a new radial drill with many novel features, just brought out bv the Lodge & Davis Machine Tool Works, Cincinnati, and designed by their chief draftsman, Mr. Henry Dreses.



IMPROVED 5 AND 6 FOOT ARM RADIAL DRILL.

Radial drills now on the market, are of two distinguished types, one with fixed column and hinged swinging arm, and the other with column swinging around an enveloped stump fastened to the base, and extending a portion into the column. The latter class, to which this drill belongs, have the advantage of being less complicated, and to swing nearly the whole circle, but, having no back support, lack stiffness in many cases. This is very noticeable during heavy drilling at the extreme end of the arm, causing the drills to break by punching them through at the termination of the hole. To overcome this difficulty, the builders of this tool have made the column of great weight and extra large in diameter. The lower part turns in an outside sleeve of increased diameter. The driving cone is placed at the base of the drill, allowing it to be driven by a long belt direct from the countershaft, without bevel gears. The vertical driving shaft is placed in the center of the column and receives its motion through a pair of mitre gears, from the cone pulley shaft. The bracket carrying the bevel gears which slide on the vertical shaft, is attached to the swinging arm and traverses in a slot provided in the rear of the column. Through this slot projects a short shaft driven from the inside bevel wheels carrying a pair of sliding spur gears of different diameters engaging alternately with the gears on the back shaft shown in the rear of the drill. By this arrangement, the change of the speeds is done rapidly and, at the same time, brings the driving gearing close to the spindle. The entire internal driving mechanism is accessible from the outside and can be taken apart without taking down the drill. The thrust bearing of the drill spindle, the column and the elevating screw denoted by letters, A, B and C, are provided with the Ross patent anti-friction ball bearing, which diminishes the friction to a great extent and avoids the oiling and cutting in these bearings. The swinging arm is very rigid and is raised and lowered by power. The drill head has an extra large bearing on the swinging arm and is furnished with the builders' patent quick return, well known from their line of upright drills. These drills are furnished with double friction countershafts arranged for tapping.

A NEW storage battery system has been devised that meets the approval of the officials of the Second avenue railway in New York, and they announce that it will soon be adopted on their line. The news seems too good to be true. The difficulties in the way are great, but if they have been overcome and a commercial success won, the ideal means of street railway traction is in sight.—[Cleveland Leader.

A CHIMNEY 350 feet high is being built for the Omaha & Grant Smelting Works, in Denver, Col. It will be an octagon stack, 55 feet in diameter at the base, placed on a concrete foundation 18 feet deep, imbedding 20 feet of steel rails. Denver is said to be several times prouder of it than of ex-Senator Taber and his night-shirts.

ELECTRICAL FORGING AND TEMPERING.

The electric forge herewith illustrated is the invention of E. E. Angell, of Boston, and is intended for heating bars of metal for forging, hardening, drawing the temper, or other purposes. The frame consists of a hollow cylinder supported upon four legs and provided at its top and bottom with a series of slots and with external lugs adjacent to the slots. In Figs. 1 and 2 electrodes are indicated by the full lines B C, and the dotted lines are pivoted to the lugs, and their long arms extend through the slots to a point near the axis of the cylinder. Other electrode levers, D E, are similarly disposed in a horizontal plane. All the levers are provided at their outer ends with binding composed of conductive material, the fusing point of which is above that of the bar to be heated. Springs are arranged to bring the inner ends of the levers toward each other for grasping the bar to be heated.

In the use of this apparatus a bar to be heated may be grasped at one end by a pair of tongs and thrust into the forge between the rolls of the first pair of electrodes. The metal of the bar closes the circuit between the rolls and causes a transverse current to pass vertically through the bar. As the bar is thrust farther into the forge it passes between the rolls of the horizontal electrode levers and a transverse current is passed horizontally through the bar. When short bars are to be heated, or a bar is to be heated a short distance at one end, one or two pairs of electrodes only may be utilized, the other electrodes remaining idle; but in heating a long bar the entire series of electrodes may be brought into play. The bar is reciprocated by the operator or by mechanical means while it is between the rolls, so as to distribute the heat throughout its length. The inner arms of the electrode levers are sufficiently inclined to prevent the binding of the rolls upon the rods in withdrawing the bar. The springs cause the electrodes to yield, and automatically adjust themselves to bars of different sizes. If it be desired to pass currents longitudinally through the bar, the wiring through the electrodes may be changed, so that all the vertical electrode levers will be connected with the positive pole and all the horizontal electrode levers with the negative pole.

Fig. 3 shows an electric forge arranged for heating lathe tools, pickaxes, and implements of irregular shape for the purpose of hardening, forging or drawing the temper. The general arrangement of the frame and the method of separating it by proper insulating material into two parts are clearly brought out in the cut. Carried upon the free end of an arm pivoted in the forged end for standard is a hub formed with radial arms, 1, 2, 3, 4, 5, 6, of highly conductive material. The ends of these arms are formed with contact heads of different shapes for contact with tools of different characters. The tool to be heated, 7, is held in the upper ends of standards. Then the hand wheel, shown in the right hand corner, is turned so as to bring the inclined standard to the proper position, when the arm carrying the hub is adjusted to the proper height by the adjusting screw. The electrode wheel is then rotated, so as to bring the electrode arm having the contact head adapted to fit the particular tool to be heated into contact with the tool. This closes the circuit through the tool, which is then heated instantly. The tool is then removed and another put in its place, and the operation is repeated.

The device for heating mandrels, milling cutters, taps, reamers, twist drills and similar articles preparatory to hardening and tempering is also shown. The upper section of the ring shaped electrode support A, Fig 5, swung back into contact with a stop on the side of the rear standard and a milling cutter, as shown, or other device to be heated, is placed endwise between the electrode spindles, F and G, Fig. 4, the spindle yielding slightly under the action of springs to permit the adjustment of the article to be heated. The upper section of the the ring-shaped holder is then closed and locked. The electrodes *a*, *a* are then adjusted, so that their ends come in contact with the sides of the article to be heated, and clamped in position by means of hinged clamping plates. The electric currents are then switched on and enter the ends of the article through the supporting electrode spindles, F and G, and pass out laterally or radially through the sides of the article by means of the stationary electrodes *a*, *a*. In order to heat the article uniformly throughout its length the operator turns the crank alternately in opposite directions, whereby the carriage carrying the electrode spindles is reciprocated, causing the work to be moved back and forth, and the points of lateral contact of the stationary electrodes to be shifted longitudinally along. The direction of the currents may be reversed or shifted.

To avoid short circuiting of the entire current through either of the branches of the positive cable during the reciprocation of the carriage and the electrode spindles, means are provided for equalizing the distance through which the currents passing through the branches travel. In Fig. 6 a disk-shaped cutter is interposed between the ring-shaped faces of the flat headed electrode spindles. The cuts are reproduced from *Iron Age*, by the *Western Electrician*.

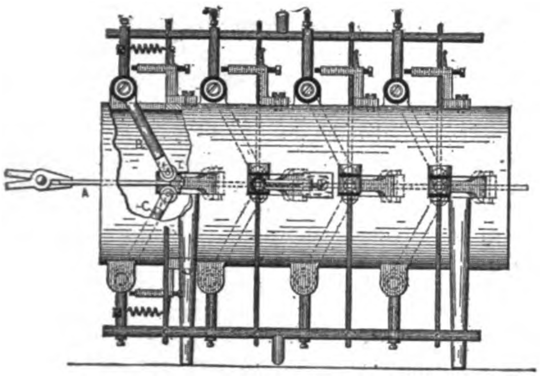


FIG. 1.

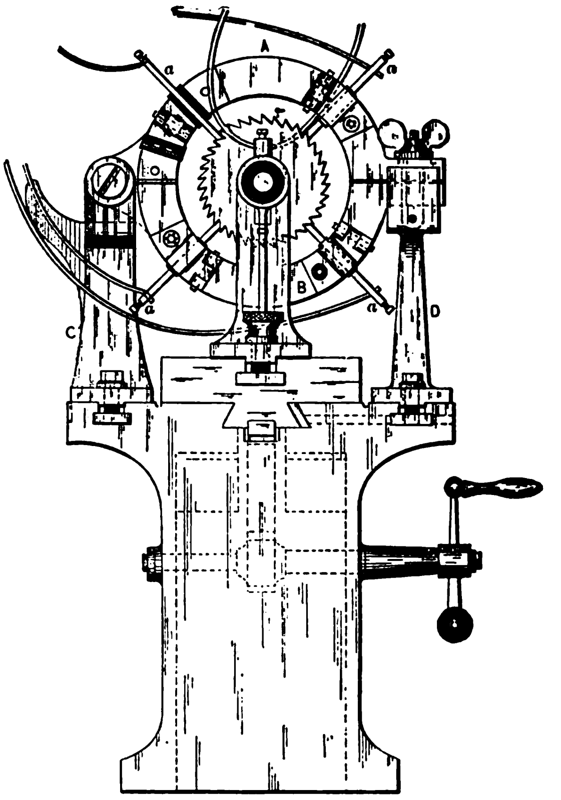


FIG. 5.

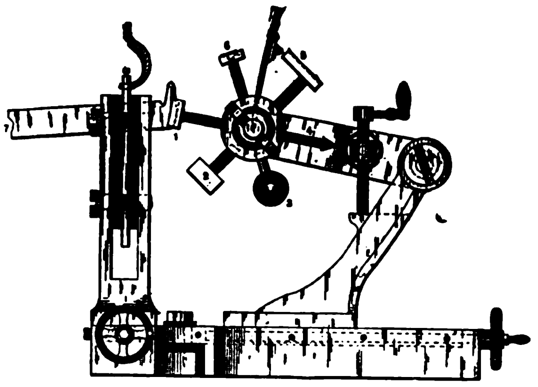


FIG. 3.

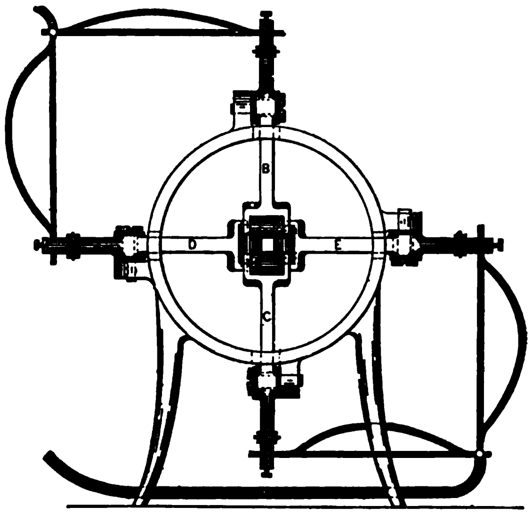


FIG. 2.

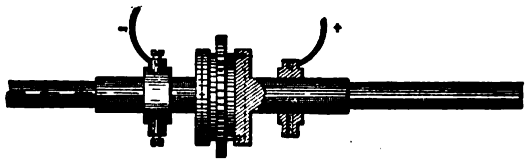


FIG. 6.

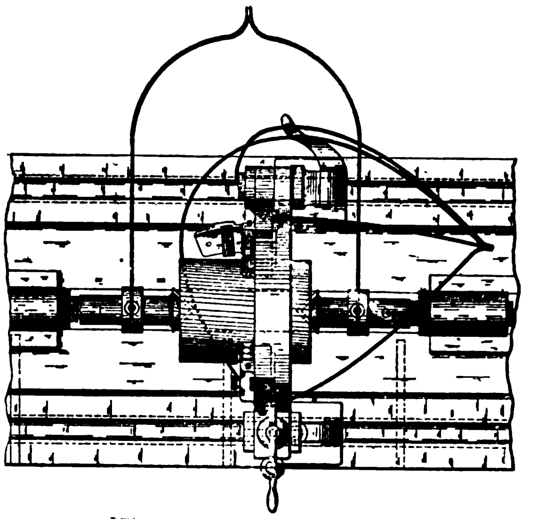


FIG. 4.

ELECTRICAL FORGING AND TEMPERING.

Management of Belts.

We watched an engine tender the other day at work on a belt, which showed above all things that he didn't understand the why and wherefore of belts and belting. Some one at one time or another had put in a short piece of rubber belting to lengthen out with, and while the leather part was all right the rubber part gave out and broke at the lace holes. What did he do? asks the Boston *Journal of Commerce*. What he had done before, cut off the ragged edge and laced it up once more, never thinking that each time the belt was shortened the tension upon it when laced increased. Every time he put the belt on it broke in less than a minute, until we suggested a new piece of leather in place of the rubber, and proposed a piece longer than the rubber was originally. "That wouldn't do; it would be too loose." But it did do, and when the load is on, that belt is as slack as it should be on the slack side. This reminds us of another case where we ran across a man lacing a belt and after every effort it broke. It looked like a hopeless task to get that to hold, when at last it went off all right. We had concluded there would be another break, so had some curiosity to see why it didn't this time. It appeared that the engineer had failed to secure the lacing when he finished, so the lacing pulled out several holes before it caught and thus lengthened the remainder to fit, practically lengthening out the belt three or four inches. The tension was enough to drive the load, but not enough so as to break the belt. It does not do to have a belt too tight. It ruins the belt and there is a big friction loss also. —[Mechanical News.

Cool Shade,

Can be found at Vermillion, O., and those who wish to attend the Camp Meeting at that place during July and August can procure excursion tickets via the Nickel Plate from June 21st to August 23rd at special rates.

LECTURES BY THE OLD MAN.

Good day, gentlemen. Be seated. To what motive shall I attribute the honor of your presence in my office at the noon-day hour? Billy, the boys seem to be making "sheep's eyes" at you, so I presume you are the chairman of this committee. What is the grievance?

'Tis not a grievance, but you have a scheme and want my advice on it. Well, that beats a grievance every time. Advice is cheap and plenty in this world, and a man has the advantage of doing what he pleases about taking it. You all want to learn drawing and think I can tell you the best way to go about it and not being rich "fellers," you want the least expensive way. You also want to know if I think it will be of any advantage to you to learn it? I should say it was a good scheme and will be of immense benefit to you. Just go bring your dinner pails in here and masticate the inheritance given you by Great-grandfather Adam, while we plan it out. Those cubs have touched my tender spot this time, sure. Is a knowledge of drafting of any benefit to a machinist? Suppose all mechanics had a chest of tools and a small annex of good drawing tools with a knowledge of their use, wouldn't their ideas of the size of the universe be more complete? Wouldn't their knowledge be greater and wouldn't their desire for increased knowledge be stronger? Consequently, wouldn't their pay be greater? Why? Haven't I found out to my own satisfaction that the more I know, the more pay I get? Understand, I don't mean what I think I know, but what I actually do know. It is not what we think we know, but what others think about it that regulates the scale of prices. When things get around to the conditions just referred to, the chap with the two pair of calipers and a 6-inch scale in his coat pocket going around looking for work and calling himself a mechanic, will cease to exist.

Now, boys, to begin with you will need a board 15"x20", a T square, 30, 60 and 45 degree triangles and a few tools; the whole outfit not costing more than $7; a book called "Inventional Geometry" and a place to get together one night every week. Also, some one to act as teacher or leader, to see that you are started right. I think this firm can furnish the meeting place in the drawing room. I also think our draftsman can give one evening a week towards your instruction, and I will drop in myself to see that you get along and don't waste any time. But you must remember that it is no play and that it means more than one evening a week for you. At home during other evenings you must practice what has been given you as a lesson, and solve problems for your books. Those questions have no answers, and you will have to think out the solution with your own brain resources. This will teach you to reason with yourself and correct reasoning develops theories, which will bear out correct practice, thus proving that theory and practice always go tohether to make success.

I would suggest that the first five lessons be devoted to learning all about the instruments; how to use them and how to handle them. Afterward, you would use your boards and tools at home, only bringing the results of your labors in to class for criticism and instruction, while we could spend the remainder of the evening in geometrical exercises on the blackboard, using a straight stick and a pair of crayon compasses, each one taking his turn at the board in demonstration. You will find that you may probably have to forego many little evening amusements and recreations and that you will have to hunt up that old practical arithmetic and brush up on the rules for converting vulgar fraction into decimals and vice versa, finding square and cube roots, etc., because we will need all of it in what we are going to learn. For as I take your request, you do not wish simply to learn how to copy what others do, but to get on an equal footing with those chaps who sit on the high stools on the upper floors.

"That's the stuff," is it Joe? All right. That is what you will get if you wish to try it. There will be no copies set for you to work from, but you will be treated just the same as if you were a real draftsman soon as you become acquainted with the instruments.

Now, that you know my ideas, you can talk the scheme over with your parents and when you are ready to go on in the matter, let me know and I will arrange the rest. But bear in mind that it cannot be all done and learned in a few days or months, but will require much patience. Neither would I desire that it should interfere with your daily shop-work. There goes the one o'clock whistle. Put your mind on your work this afternoon and learn all the kinks you possibly can and get all the interest available out of the five talents the Master has given you.

THE OLD MAN.

A SET OF FINE TOOLS.

BY WM. HARRISON.

When Mr. Adams left his home on the important errand of recovering the articles that had cast such a shadow over his life, he did not know exactly what to do first, but quickly made up his mind. We can not follow him in the pursuit of the fine detective work he accomplished, but suffice is to say that he suddenly ran upon the man he wanted to meet (in a few hours)—Harry Bellknap. Not being ready for Mr. Bellknap, he scarcely knew how to handle him.

The black-eyed man took in the inventor at one furitive glance, anp his manner showed that he was not decided whether to recognize him or to turn into the billiard room in front of which he was standing when espied. But for considerations that we cannot make known, he chose to accost Mr. Adams, with an affability which only a man of nerve has under such perfect command.

The conversation did not touch upon the subject uppermost in the minds of both for a few moments. But it was soon introduced by Mr. Bellknap. "Mr. Ashton did not call on you to-day, as he expected to do," he said. "I do not know just what kept him, but I suppose it was impossible for him to do so. It is blamed unfortunate about those tools. You see some burglar got a knowledge of them and conceived the idea of converting some of them to a use for which they were never intended. At least I suppose he must have had this in mind, judging from the development and from the fact that no other object can be seen. We knew that they were taken, but not until afterwards did we learn that your real name is on every one of them. The unfortunate part of it is that the fellows who now have them, having observed the close resemblance a number of them bear to burglar's tools, think they have you in a corner. They have had the cheek to communicate with us on the subject. They claim to have it in their power to send you to the penitentiary, and if this is true, they will be hard to deal with."

Mr. Adams said nothing. He would have given a five hundred dollarbill had he been able to clinch a certain piece of evidence, which he soon expected to possess, before meeting this man. But not having it he considered silence the wisest.

"We have tried in every possible way to induce them to give up the tools, but it won't work. We would pay their price in a minute if we had it, but we could not come within forty thousand of it. We are, however, willing to help you out to the amount of ten thousand, but we must leave it to your judgment whether you will take advantage of our offer which we consider liberal. D——n the whole business! What a nest a fellow will drop into sometimes! This is bad on us and worse on you. The gang, however, see that they have a strong string to pull and they propose to pull it. Being hardened, notorious characters, they can not be intimidated, but will stand out to the last."

"Well, what is the proposition?" asked the inventor.

"Their proposition," answered the beady-eyed man, "is to deliver us the tools, every one, for fifty thousand dollars. Our proposition is to relieve you of ten thousand of it."

"The object is to relieve me of forty thousand, I guess," said Mr. Adams, looking steadily into the face of Mr. Bellknap.

"I do not know what you mean," said Bellknap, "but, if you do not wish to construe it in the fair and liberal spirit in which it is given, we can not help it. The misfortune is yours, and while we much regret it and are willing to help you out to the utmost of our ability, we are not disposed to make it our own. It is a matter that concerns you very much, and it seems to me that the only question is, whether your reputation is worth that much. If not, I would resist it to the last, but if it was me, I would take up the offer before it is raised. I am sure it will never be lower."

A sinister expression lurked in Bellknap's eyes and played around the upper portion of his dark face, as he uttered the last sentence, which would have satisfied most any one having an ordinary amount of penetration that he was one of the miscreants who fixed the price.

"Perhaps I will and perhaps I will not consider my reputation at stake," said Mr. Adams. "It is very interesting information that you give me, and I owe you thanks for your liberality and counsel. But I should like very much to see or communicate with the party or parties. I surely can wait till they open up negotiations."

"Your head is level on that, sir, judged from the standpoint of ordinary business," returned Mr. Bellknap, "but the question of policy comes in here. You might lose your fortune by acceding to these outrageous demands, but then you might thereby ally yourself to another. The chances are, I fear, that by standing off on this you will lose both, for these gentry are hard at work on Mr. Ludlow, and they are very sure to prejudice him against you violently and for life, if the business is not soon stopped."

Mr. Adams experienced a strange sensation. What was his fortune compared with the lady of his choice? Forty thousand would cripple him, but by hard work he could recover the ground. Bellknap saw that an impression had been made on him, and followed it up with more in the same line. But Charlie Adams was not a man to submit to the rifling of the mountebank without a violent struggle.

"I can only repeat what I have already told you," he said. "I will think the matter over and will answer in a short time any one who can show that he is the mouthpiece of the burglars, or *gentlemen* who have the tools and think they have me also in a box. Good night."

"We'll fetch him at last," said Bellknap, turning into the billiard room. "But I wonder where Ashton is. I don't exactly like his behavior. But then, I always was suspicious."

Mr. Adams slept but little that night. In the morning he was preparing to continue the work of the previous evening when he received a note from Mr. Ludlow as follows:

"SIR:—I was in hopes that the dark suspicions resting upon you would be explained away satisfactorily, and pending such explanation was disposed to accept your statement. But it can no longer be doubted that you have done criminal work and have been in collusion with criminals. Words can not express my indignation that you have so successfully imposed upon me. It is my duty to denounce you openly, which I shall do. The police, in a few hours, shall have possession of all the facts.

CYRUS LUDLOW."

Charlie Adams leaned back against the wall and turned deathly pale. Matters had reached a climax, and it looked very much as though his stupidity in not recognizing those tools as burglar's instruments had ruined him entirely.

He feverishly drove down to his office. Entering his private room, he was nearly bereft of speech to see seated there Mr. Ludlow, Mr. Ashton and the Chief of Police

"The crisis has come," he said to himself, "but I will do nothing unworthy of myself,—will bear it like a man."

He bade them good morning and closed the door. As he did so there passed the hall window of the general office a face, the sight of which set his heart to pounding violently. He heard the quick, soft words of a familiar and dear voice, and the next moment a clerk rapped at the door, pushed it ajar and said, "A lady to see you, Mr. Adams."

Mr. Adams arose, but through the nearly closed door, the lady caught a glance of Mr. Ludlow, and, gently pushing it open a little wider, slipped into the private office. It was Theresa Ludlow. Though veiled, her face showed the traces of her suffering, and her nervous manner bespoke the strain she had endured for many weeks.

There was an oppressive silence for a moment, which Mr. Adams broke. "Let me preface whatever is to come by declaring that I should and shall bear alone the consequences of any indiscretions committed," he said. "This must not be a calamity to any one but myself."

Theresa stepped forward as if to speak, but her father, rising, intercepted her.

"I know what you would say, Theresa," began Mr. Ludlow, with a gravity of countenance and a measured tone that gave a premonition of evil, "but it can serve no good purpose and might as well be omitted. I am not sorry for these developments, and trust that you will bear patiently anv ordeal in store for you. I must leave Mr. Riddell to perform his duty."

With a solemnity unequaled he took his seat. The individual known as Mr. Ellis, alias Ashton, now arose. His manner was easy and his aspect not at all threatening.

"I have for many months," he said, "been following up a side issue, but not on my own responsibility. In the pursuit of my business as an employe of our national uncle, in the department burdened with the responsibility of looking after the expert operators, who run in competition with our Treasury, I happened to get on the track, as I thought, of a coterie of gentleman who take what they want first and ask for it afterwards, if at all. I have spent a long time in satisfying myself that our friend here does not belong with them and never did. If looked very much for a time as though he really knew what a certain *set of fine tools* he made were intended for. Perhaps the investigations of that matter were prolonged by using this same gentleman as bait for one of the gang before alluded to in order to draw him on. It was one of the toughest jobs I ever had, but the end is now reached, and they are safe."

Mr. Riddell paused a moment; then, reaching behind his chair, he drew forth a basket and handed it to Mr. Adams.

"Please receive this set of instruments, unequaled in temper and finish, from the Chief of the United States Secret Service, whose subordinate I have the honor to be. You did not, I have come to believe, recognize in them when you made them, the finest kit of burglar's tools a government agent ever laid eyes on. But you will probably not soon forget what such articles look like. They are all there except the one that Mr. Ludlow has. That got away from me, while associating with the most skilled clique of robbers I ever had any experience with, every one of whom, including our friend Bellknap, is now behind the bars at the county jail."

Mr. Adams and Theresa were overcome with astonishment and joy. The meeting soon broke up, only to assemble again in Cyrus Ludlow's mansion, where a general feast was participated in.

It was not long after that another and scarcely less felicitous festivity was held at the Ludlow residence, in celebration of the nuptials of the professor and Miss Theresa.

There was one humble guest there who had occasion to feel grateful to the inventor; that was Joe Miller—now the assistant draftsman for the Adams' Manufacturing Co., and subsequently a machinery designer of great repute.

(The End.)

Cleveland City Relief Corps Excursion.

The Women's Relief Corps, No. 75, Auxiliary G A. R., will run an excursion to Niagara Falls via the Nickel Plate on Saturday night, July 30th. Train leaves Cleveland 10.00 P. M. $3 00 round trip. See bills for information. Tickets for sale at the following places: E. R. Hull & Dutton, Co Operative Clothing Co., J. L. Hudson Clothing Co., J. W. Deutcsh 2728 Broadway, Trodman's Grocery, Corner Harvard and Sawyer Sts., G L. Haefele 1575 Pearl St., G P. Herman, Corner Wilson & Woodland, Chandler & Rudd Co., Euclid & Wilson and Nickel Plate Agents.

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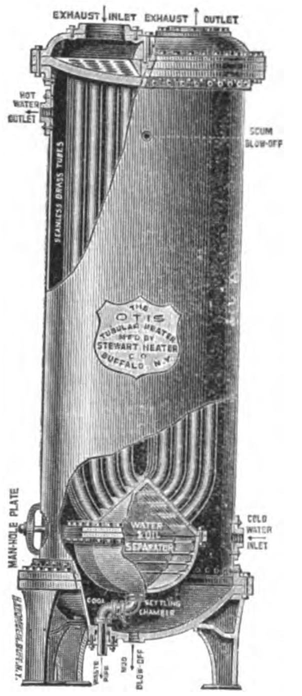

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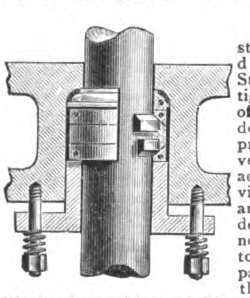

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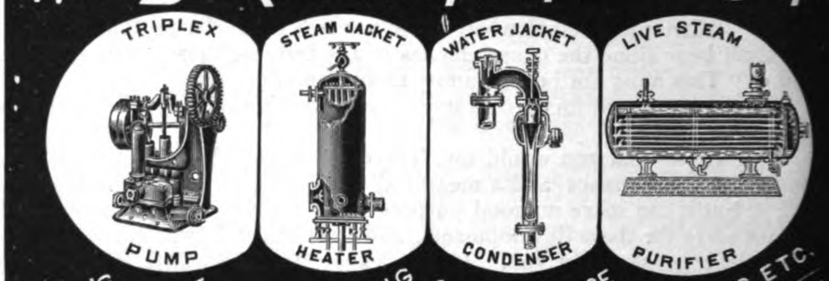

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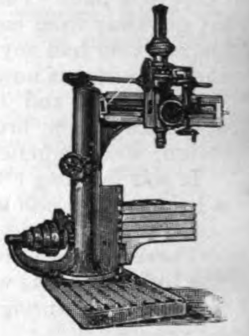

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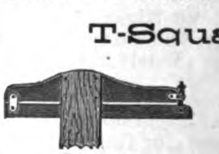

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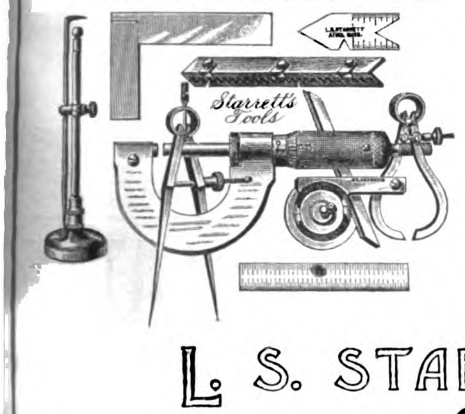

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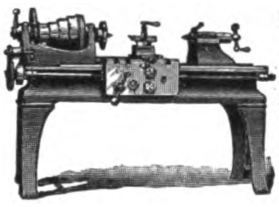

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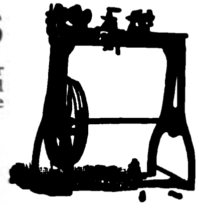

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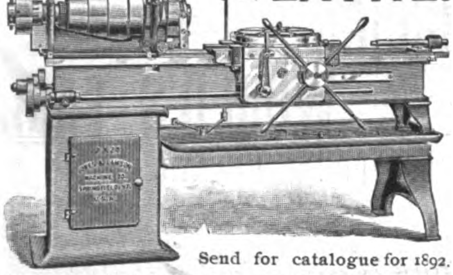

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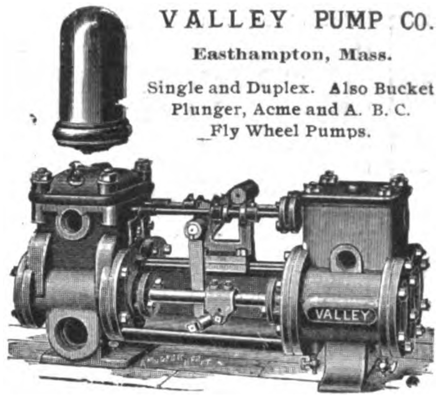

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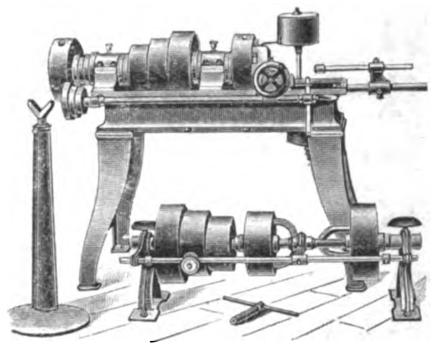

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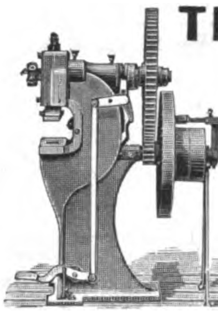

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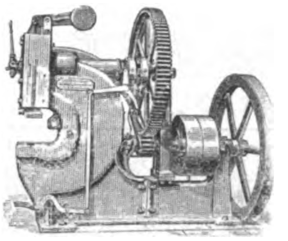

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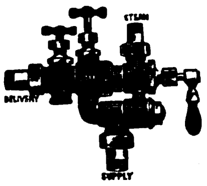

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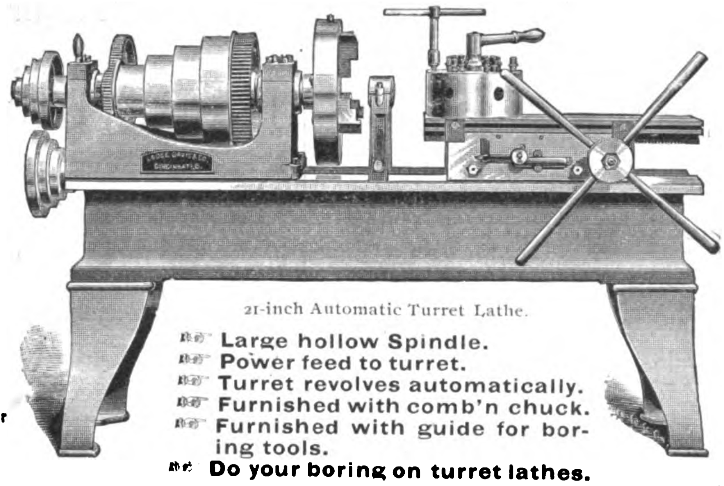

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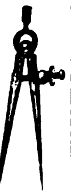

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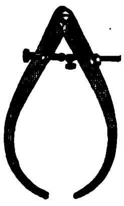

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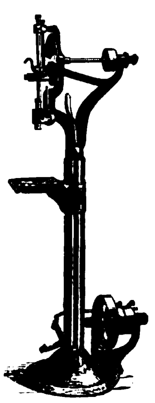

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SCIENTIFIC MACHINIST

DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES.

ESTABLISHED, 1882. CLEVELAND, O., AUGUST 15, 1892. VOL. X—NO. 16. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. TERMS:—$1.50 A YEAR, SINGLE COPIES, 7 CENTS.

THE COOK BOILER.

The illustration on this page shows a new boiler, invented, designed d patented by Mr. Herbert F. Cook, the chief inspector of one of the est boiler insurance com- ies in this country, who has e a special study of steam erators, in which line he has quired a very creditable repu- tion.

The utilization of waste heat s for years engaged the atten- on of the best mechanical engineers of the country. It is now interesting manufacturers more than at any previous time, and this boiler deserves the careful consideration of every concern in which the economical use of waste energy is a factor in the increase of dividends, having been designed for this special purpose.

It is a water tube, vertical boiler, set in brick work, as shown in the cut. The object of this boiler is to secure the most complete circulation by having all passage ways perpendicular to a direct line to the circulation of water, there being no curved passages, thus leaving a clear, direct opening from top to bottom of the boiler. There are no flat or horizontal surfaces that sediment can accumulate on, except the bottom of the lower chamber, which is below the effects of the fire, at the same time being a chamber so arranged that water is at all times in circulation. The outer tubes being the thinnest material, containing the smallest body of water and exposed to the greatest heat, causes the circulation to be upwards through these outer tubes and downward through the large flue in the center, in which is a larger body of water and protected from the fire by the surrounding tubes, thereby gaining complete and positive circulation from top to bottom, with separate passage ways for upward and downward currents of water.

The upper chamber is incased in brick work, so that there is no radiation of heat, as there is from the dome of an ordinary tubular boiler that is exposed to the atmosphere, but on the other hand acts as a superheater, by which steam is brought to the maximum of dryness. The tubes are so arranged that they can be taken out and replaced very quickly if necessary, the holes in the tube sheet of the upper chamber being made 1/8″ larger than the tube, with copper ferrules on so that when the tubes are loosened for the purpose of taking them out the lower end will cant over far enough to allow them to be slipped down the side of the boiler and passed up between the brick work and the outer side of the upper chamber. Where there is bad wâter, under which conditions other boilers have failed to work, becoming entirely clogged up with hard, tenacious scale, this boiler has run continually without showing scarcely any deposit of sediment or of scale upon the tubes or sheets, the refuse substance being preserved in the form of mud, in the lower chamber, where it is easily blown off.

The Cook boiler has been examined by a great many rolling mill and furnace men and mechanical engineers, well posted in this branch of boiler practice, who have given it their approval. But the evidence of the remarkable economy and efficiency of this boiler does not rest on the opinions of those who have examined it. It is doing work in mills every day. Perhaps the one at the Cherry Valley Iron Works, of Leetonia, O., has been subjected to the most rigid test, the water there being about the worst conceivable. In this works are several different kinds of boilers for utilizing waste heat from puddling and heating furnaces. At the time the Cook boiler was installed, it was necessary every week to put a number of new tubes in one of the other boilers, which is used very largely now. When an inspection was made, a scale on an average of 3/4″ was found on the tubes of the boiler above mentioned, while there was no scale at all on the tubes or sheets of the Cook boiler, only a very slight coating of matter that could be easily scraped off with the thumb nail, and so thin that the marks of the tube expander were seen through it.

The following letter explains itself:

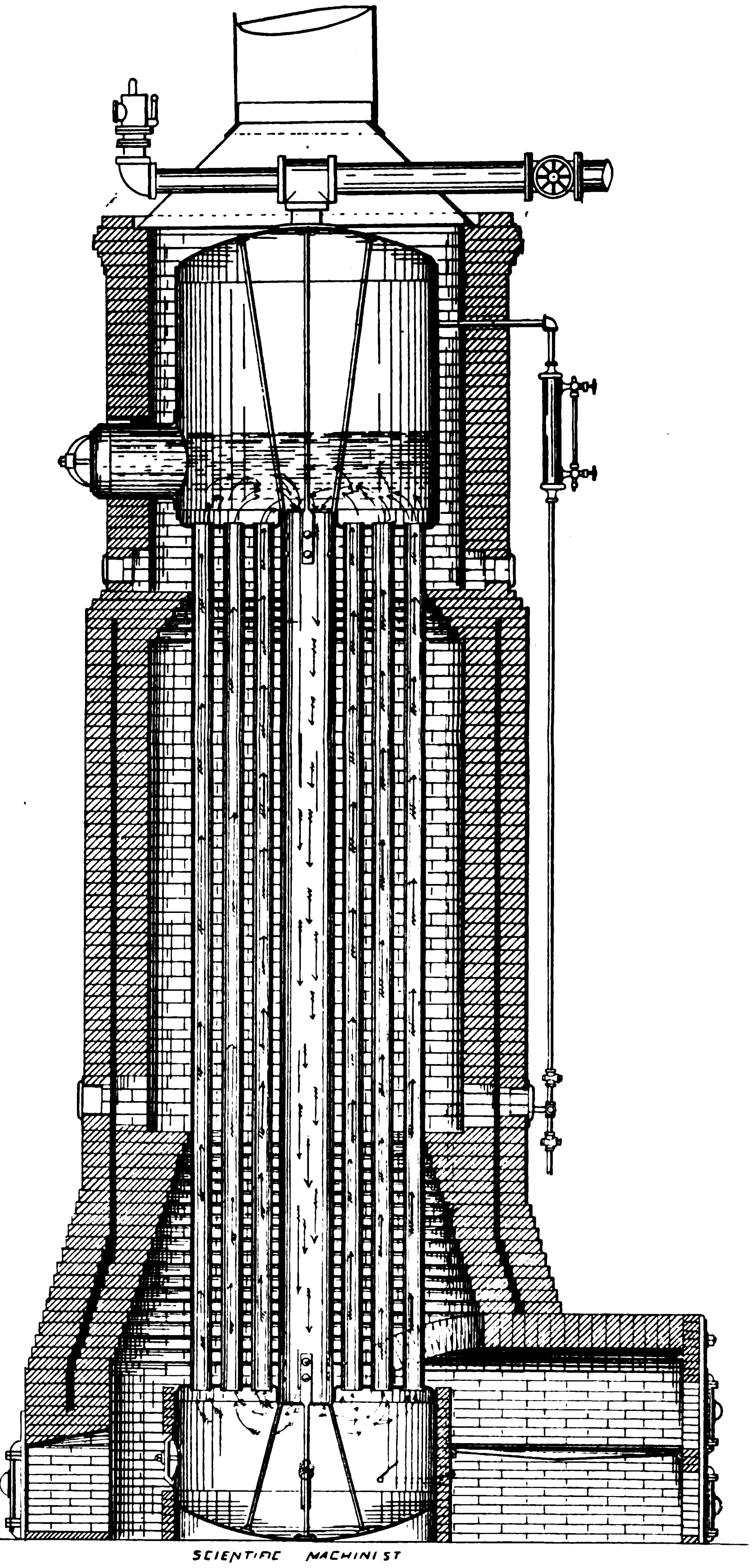
LEETONIA, O., July 13th, 1892.

H. A. Fuller, Treas., Union Rolling Mill Co., Cleveland, O.

DEAR SIR:—We are in receipt of your esteemed favor under date of July 12 making inquiry in regard to the Cook boiler that we now have in operation over our bar mill heating furnaces at our rolling mill, and wish to say in reply that the boiler is in every respect a complete success and would not give it for two Hazelton boilers, of which we have several in our mill. It is a great steamer and we are having no trouble whatever with tubes filling up as we have with the other boilers; in fact the repairs on this boiler since we have had it in operation has not cost us 50 cents, while we are constantly obliged to put in new tubes and make other repairs to the Hazelton boilers. It is on the right principle and you will make no mistake, if you put in some waste heat boilers, in taking the Cook. The boiler we put in is 100 H. P., and we have been getting as high as from 140 to 150 H. P. from it since we have had it in operation.

C. N. SCHMICK, Treas.

The Aultman & Taylor Machinery Co., of Mansfield, O., are the builders of the boiler, and will furnish details and prices on application.



THE COOK BOILER.

"CUTTING OUT THE NINES."

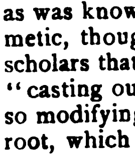
Rule for Proving Square and Cube Root.

BY JEARUM ATKINS.

In the old time arithmetics, which the writer used when a boy, 60 to 70 years ago, there was a rule for proving the operation of multiplication and division, and may also be employed to prove addition and subtraction, though it was not much used to prove the last two named operations, so far as was known to us. We have never seen this rule in any modern arithmetic, though we have never searched for it, and have been told by modern scholars that they never saw any such rule. This mode of proof was by "casting out the nines." In later years, the writer discovered a way of so modifying this rule that it can be employed for proving square and cube root, which discovery, so far as known, was new at the time it was made by us.

This rule for proving square and cube root has been found to be very useful to the writer, and thinking it may be so to others, will give it here, together with the old rule, formerly in vogue for proving multiplication and division.

Suppose now that you wished to prove this case: 3,684×7,315=26,948,460; cast the nines out of the multiplicand, (3,684) or divide this number by nine, and set the remainder, or the excess over even nines, which is 3, at the right hand of a cross, thus: then cast the nines out of the multiplier, and set the excess or remainder over even nines which is 7 at the left hand of the cross against the 3, multiply this last remainder by the former one thus: 7×3=21, add the 2 and 1 together, 2+1=3, and set the 3 at the bottom of the cross. Should the sum of these two figures be over nine set the excess in place of the three at the bottom of the cross. Then cast the nines out of the product and set the remainder (3) at the top of the cross, which agrees with the 3 at the bottom of the cross, thus proving that the work is correct. If in any case these two last figures do not agree, it is proof that the work is incorrect. This seems at first to be complicated and laborious, but with a little practice it will be very simple and quickly done, and is a perfect protection against letting work go out of your hands containing errors which are liable to cause you much trouble.



In all cases in which you carry out the answer into fractions the last remainder in casting out the nines is used as if the numbers were whole numbers, and this applies to all cases of casting out the nines.

To prove the operation of division, cast the nines out of the quotient and set the excess over even nines at the right hand of the cross, thus: Cast the nines out of the divisor and set the excess (7) over even nines at the left hand of the cross. If the excess over nines in either of these last cases or any case is more than nine, set down the excess over nine as directed. Multiply the excess over nine at the right hand and the left hand of the cross together, and add the remainder (5) after division, and set the excess over nine (6) at the bottom of the cross. Lastly, cast out the nines from the dividend, and set the excess (6) at the top of the cross, which last figure agreeing with that at the bottom of the cross, proves that the work is correct, otherwise it would be incorrect.

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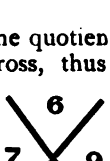

To prove square root let us first extract the square root from the simple number 626, thus:

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   6.26(25
   4
   ——
45)2.26
   2.25
   ——
      1
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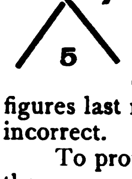
Proof, cast the nines out of the root, and set the excess or the remainder (7) at the right hand of a cross, thus:—Square the remainder 7×7=49, add to this the remainder (1) after exhausting the square root (49+1=50;) cast the nine out of this (50) and set the remainder, 5 at the bottom of the cross. Lastly cast the nines out of the dividend, and set the excess, or remainder 5, at the top of the cross, and this last figure (5) agreeing with the 5 at the bottom of the cross, proves that the work is correct. If these two figures last named do not agree in any case it is proof that the work is incorrect.



To prove the operation of extracting cube root, the process is exactly the same as that given above for proving square root, with this difference only. After casting the nines out of the root, cube the remainder instead of squaring it, as in case of square root, using this cube instead of the square of the remainder as in the former case.

The writer in the course of his business, has often had occasion to obtain the cube root of large numbers, which is quite a lengthy operation, involving the use of many figures, and some liability to commit errors, which when they occur are sometimes the cause of considerable mischief unless they are corrected in time, and it is quite a tedious job to correct such errors, by any process known to us, unless it is by the rule given above. In extracting cube root I generally apply the proof after working off each period, and obtaining a figure in the root, then when I am "sure I am right, go ahead."

The number nine has been justly termed a "mystic number" for there are principles connected with it which have never so far as known been fully demonstrated. One curious law of the number nine not found in any other number is, that every multiple of nine upon casting out the nines by adding the figures, gives even nine without any remainder. Thus 9×2=18, add the figures in the product and 1+8=9. 9×3=27, again 2+7=9, 9×4=36, and 3+6=9, 9×5=45, and 5+4=9, 9×6=54 and 5+4=9, and so on through hundreds, thousands, millions or billions, alike.

It is in this way that we cast out the nines from any number. Suppose you wished to cast out the nines from the number 943. Commencing at the left hand, drop the nine, paying no attention in any case to the figure 9; then say 4+3=7 which is the remainder after casting out the nines, no matter how many times nine goes in the number, the remainder being all you wish to use, never in any case going to the trouble of making up figures in casting out the nines. It is this peculiar law of the number nine, as set forth above which, renders it possible by its use to prove all the mathematical operations as above shown and many more, but to demonstrate all the reasons of all the complications of its working to their ultimate is not within the scope of this short article.

The law above explained, that the addition of the figures of every multiple of nine gives even nines, was the discovery of the writer, although somebody else might have made the same discovery before, for aught we know, and this latter discovery led to the invention of the rules for proving square and cube root, but to give an explanation of the reasoning by which these results were reached would be tiresome alike to the writer and reader. —[Power and Transmission.

THE USE AND MISUSE OF PETROLEUM AS FUEL—II.

ABSENCE OF SMOKE AS A CRITERION.

Now, as to the effect of these conditions—first, as to the feature o economy of consumption of the oil, and then as to the safety and wear an tear of the boiler and furnace. As the criterion of perfect combustion the popular idea seems to be the absence of visible smoke from the chimney. It need hardly be said that this supposition is erroneous, and tha some of the most valuable portions of the fuel resulting from its primary partial combustion—although in the form of gases—are totally invisible. In the case of boiler firing, the consumption of fuel is regulated entirely with reference to the steam pressure, as indicated by the gauge; all varia tions being met by a corresponding increase or decrease of the flames, an in making this adjustment, it is necessary that the initial combustion shal give about 75 per cent. of the evaporation, the remaining 25 per cent. being accomplished by the highly heated waste gases. As the relative quantities of oil and of steam or compressed air must be such as to prevent the formation of smoke, the point of adjustment must be such as to give this effect and at the same time maintain the desired steam pressure, the result being waste.

The reasons are simple. In the first place, the very high temperaure of this combustion renders it impossable for the heat to be transmitted by the material of the boiler plates to the water to form steam. The maximum rapidity of such transmission is governed by the relative conductivity of iron or steel and any application of external heat which exceeds thi limit must necessarily result in a higher temperature on the outer surfac subjected to it than on the inner surface from which the heat is absorbed by the water. The waste of heat, moreover, is not the only result, as it i dangerously destructive to the natural molecular structure of the metal and becomes a constant menace to the safety of the boiler. Externa scales and blisters and internal crystallization of the plates are sure t result from this concentration of heat on such a comparatively small por tion of the surface of the boiler. In addition to the above effect there ar the strains due to the unequal expansion of different parts of the shell, an even of the same plate, which affects the mechanical construction of th boiler as well as the physical structure of the material. The formation o scale in the boiler is always greater upon portions of the plates or tube exposed to the highest heat, and this is another source of danger, as by preventing actual contact of the water with the surface of the metal th liability of burning or overheating is imminent. The effect on the furnace though, of course, not nearly so serious in its results, is nevertheless o considerable importance as an item of expense. Almost invariably ther will be found a mound of hard carbon deposit at a point where the primary combustion is most intense. Often this deposit is so rapid as to require it frequent removal in order to admit of sufficient passage for the flame, t enable the boiler to hold the required pressure. As the deposit is very hard it requires very considerable force to detach it, which is more or les demoralizing to the fire-brick work. The latter also, being naturally of quality suited to the moderate temperature of boiler firing, are unable t stand the greater strain upon their refractory qualities, which ofte approaches a full steel heat. The result is a puddle of slag from fused brick and clay, which causes more or less damage to the contiguous parts.

Since the combustion is so greatly forced at its primary point it is impossible to effect the necessary admixture of air with the spray from th burner to cause the oil to be burned to water and carbonic acid, the products of complete combustion of hydrogen and carbon. While the adjustment of the steam or air blast prevents the formation of free carbon a smoke, and only so much is formed as causes the hard deposit above referred to, the quantity of oxygen present in the possible air supply i only sufficient to form water with the hydrogen and carbonic oxide wit the carbon, thus leaving the entire volume of the latter to pass to th chimney, its only useful effect being the giving up of its sensible heat t the water, and its principal value from its combustion to carbonic acid i totally lost. Of course the total loss of carbonic oxide is an extreme o this class of improper firing, but it is by no means an unusual case. There are many instances of boilers in operation to-day in which the cost of oil firing is as much as double what it should be with even ordinarily good practice, and a few figures on the subject from a theoretical standpoint may serve to illustrate how serious a source of loss this imperfect though

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Mention this paper. JERSEY CITY, N. J.

smokeless combustion may become, as compared with the full theoretical possibilities; and also the commercial value attained by some of the better methods of utilization, the latter, of course, being more applicable to the practical operations we are considering in the present connection.

THEORETICAL FIGURES.

Without further present reference to the hydrogen contained in the oil than that it amounts to about 13 per cent. by weight, and is burned to water, the 85 per cent. of carbon shows the following figures. By results of experiments by Dulong, the total heat units generated by the perfect combustion of one pound of carbon (to carbonic acid) amounted to 12,906, while the partial combustion—to carbonic oxide—gave but 2,495 units. Favre and Silbermann found the total value to be 14,544, and that of the partial oxidation 4,453. From this we see that while the probably unavoidable difference in conditions of these experiments causes considerable discrepancy as to the total value and that of the initial combustion, yet the value of the carbonic oxide is practically the same, as follows:

Dulong, $12{,}906 - 2{,}495 = 10{,}411$ units = value of 1 pound carbon n form of carbonic oxide.

Favre and Silbermann, $14{,}544 - 4{,}453 = 10{,}091$ units = value of 1 pound carbon in form of carbonic oxide.

It is immaterial for our purpose, therefore, which of these authorities we select, as both are accepted as standard. According to the latter, then, we find the combustion of one pound of oil to water and carbonic oxide to give a heating value, for carbon only, of $4{,}453 \times 0.85 = 3{,}785$ heat units; while the value of the wasted carbonic oxide $10{,}091 \times 0.85 = 8{,}577$ units, or a loss of 68.6 per cent. As the calorific value of hydrogen, as given by Dulong, is 62,535 heat units, the value of the 13 per cent. contained in the oil will be $62{,}535 \times 0.13 = 8{,}130$ units, or practically the same as the quantity lost by wasting the carbonic oxide. The proportion of the total value of the oil lost from this cause will be $\frac{8577}{20475} = 41.89$ per cent. It must be borne in mind that this percentage of loss is due entirely to direct waste of the fuel itself and not of the heat due to its combustion. That the latter is also a serious source of loss may be readily understood when it is remembered that during the combustion there is sufficient of the heat abstracted to raise the temperature of the volume of carbonic oxide, and also that of all the air admitted to the furnace to support the combustion. This latter being generally in excess of the actual requirements—with the object of preventing smoke—carries with it a very large percentage of heat which should be otherwise absorbed by the water in the boiler. This percentage, of course, is dependent on the temperature of the waste products of combustion as they enter the breeching to smoke stack, as while they are in contact with any portion of the heating surface of the boiler they are giving off their heat to the water. From the foregoing it is readily seen that double the necessary quantity of oil may be expended and an apparently perfect combustion maintained, and that while the oil bills may suggest the idea that oil is an expensive fuel, it is only by comparing the carefully ascertained results with the known capabilities of the il that the fault can be shown to be not with the article itself, but with he improper method of its utilization.

INADEQUATE AIR SUPPLY.

Other systems there are which, while giving possibly slightly better work, are still so faulty in principle and construction as to prevent anything like satisfactory results being attained. Some of these are of a character most deceptive in operation, from the fact that they show an apparently excellent combustion, the flame being long and of low velocity, and entirely enveloping the heating surfaces of the boiler. A close examination, however, reveals the fact that the flame is of very low intensity and possesses but little heating power, as shown by the absence of even a ow degree of incandescence of the brick-work of furnace, as well as the low steaming of the boiler. In this case the fault lies principally with the ir supply, the quantity being inadequate and method of admission incorrect. Of course such a flame will not be possible without the chimney howing more or less smoke, and it is not unusual to see boiler chimneys where oil firing is used giving out clouds of smoke equal to that discharged from the stack of a rolling mill furnace using bituminous coal.

THE REMEDY.

Now, as to the remedy for this misuse of so valuable a heating agent. While it is not the intention of this article to prescribe a formula nor to design a furnace, a few of the principal essentials for attaining better results may be suggested. Of course the common-sense solution of the difficulty y the non-technical steam user would be the employment of a competent urnace engineer, whose business it is to understand the requirements and upply the means. But as this may not be convenient or practicable in all ases, the following may be useful as a hint in the right direction, if nothing more:

First, as to the selection of the burner. For boiler firing those using team for the blast or jet are more convenient than the compressed-air ype, and should be more economical, not only because direct steam is heaper than compressed air, but also that a portion, if not all, of the contained water in the steam should be dissociated by the high temperature of he flame and the presence of a sufficient quantity of carbon, thus producing a percentage of so-called water gas. The burner should be capable of iving a spray of very finely divided oil, thoroughly mixed with the steam. he atomizing action should be purely mechanical, and not due partially o the heat of the steam. It is also a pre-requisite that the proper quality nd quantity of vapor shall be supplied without requiring a high velocity of ast. As a test of this feature it should be possible to ignite the spray by sing a lighted match only, and this cannot be done if either the velocity too great or the vapor not thoroughly mixed. There should be but little ise from a properly adjusted burner, and the deafening roar so common n the fire-room where oil is used is not only unnecessary, but indicates mproper action of the burner.

The next point to consider is the method and location of attachment. his should be at a point in the boiler front which will enable the delivery of the spray centrally, as to width, in the forward part of the fire-box, which latter should constitute a preliminary combustion chamber, from which the flame may be uniformly distributed through the entire boiler setting. The method of attachment should be such as to provide for the regular admission of the air necessary for the initial combustion, which air must mix with the vapor at or before the point of ignition. A moderate degree of regeneration of this primary air supply is very desirable, as giving much higher temperature of the initial combustion, without consuming any more of the fuel at this point than when cold air is used. The quantity of air should be only sufficient to convert the carbon to carbonic oxide, which, by means of a supplementary supply of hot air, will give a secondary combustion yielding a mass of flame sufficient to fill the furnace. The regeneration of the air supply may be effected without difficulty by means of ducts built in the hearth and walls or the furnace, where a portion of the heat absorbed by the air and returned directly to the furnace may be considered as waste heat utilized. An important feature of the furnace is the means for mixing the gases and hot air, and for retarding the velocity of the draft, in order to hold the flame in contact with the boiler as long as possible. A very effective method of accomplishing these two points is to build a serrated or checker work bridge wall and hearth, and a rampart at the back connection. In a properly constructed boiler furnace, properly fired with oil or gas, the entire mass of fire-brick work should become highly incandescent, and by its reflected heat effect a large percentage of the total evaporation. Its high temperature also very materially aids in the completion of the combustion of the gaseous portions of the fuel. It is the chimney draft and not the blast from the burners which should give current to the flame. This, as well as all air admissions, should have convenient individual regulation, as their adjustment is an important factor in obtaining the best results. Mica peeps should be provided, both at front and back ends of furnace, as it is important to be able to observe the character of combustion and condition of brick-work, as to whether the proper degree of incandescence is maintained. In case it is necessary for convenience or otherwise that the flame from burners impinge upon any portion of the brick-work forward of or at the bridge wall, there will invariably be a deposit of carbon, which will be a source of inconvenience unless means are taken to prevent its accumulation. As the surest method is the admission of sufficient air at the point of deposit to effect its combustion, and as this is about the most desirable point at which the secondary admission can be made, there need be no difficulty from such cause. One of the most vital considerations is that the air admission must be correct as to method as well as quantity. For instance, if the secondary supply be admitted at a point where the temperature of the imflammable gases has been considerably reduced, it must necessarily fall below the point of ignition unless the air be sufficiently heated to supply the deficiency, and, as the result, the two requisites for combustion—fuel and oxygen—although thoroughly mingled, pass to the chimney unconsumed, for lack of a few degrees, more or less, of the required temperature to effect their combination. The moral is, See that the supplementary admission be not too late, and have the air heated, if possible, even at the cost of a little extra trouble. There are steam plants in operation to-day which fully demonstrate the correctness of what has been said on this subject, and if such were the rule, instead of the exceptions, there would not be any question as to whether oil fuel pays. While its application to steam plants only has been referred to, the same principles will apply to furnace work of any kind—the application, of course, being carefully adapted to the requirements of each individual case. Undoubtedly the generation of steam presents greater possibilities for economical use of fuel than almost any purpose for which it is used, and for this reason it was selected as the subject of the foregoing remarks.—[Iron Age.

Another Victory.

The Hine Eliminator has scored another victory which, if possible, rivals the one already gained by the celebrated decision of Prof. Thurston, in its favor. The following is the report of a test from Prof. Geo. I. Alden, of the Polytechnic Institute, Worcester, Mass., on July 12, 1892, instituted with a view only to ascertain the comparative efficiency of their horizontal style as compared with the vertical:

WORCESTER POLYTECHNIC INSTITUTE,
Department of Mechanical Engineering.

Hine Eliminator Co., New York:

GENTLEMEN—The test of your horizontal eliminator was completed some weeks ago. We followed substantially the method employed at Cornell in the test there made of the vertical eliminator. With different qualities of steam entering the eliminator, we found that the steam after passing through the eliminator was nearly dry, the Calorimeter showing from 98.28 to 99.48 per cent. of steam. All our results came between the above figures. Our experience leads us to believe that, with the kind of Calorimeter used to determine the quality of the steam when very wet and before entering the Eliminator, it is impossible to get accurate results, because the water is not mixed with the steam, but flows along the surface of the steam pipe. For this reason we do not attempt to give the exact amount of moisture in the steam before it entered the Eliminator. We know, however, that in some of the trials there was not less than 40 per cent. of water in the entering steam. Our test, therefore, shows fully as high an efficiency for the Horizontal as does the Cornell test for the Vertical Eliminator. Yours very truly,

GEO. I. ALDEN,
Prof. Mechanical Engineering Wor. Pol. Inst.

W. H. WRIGHT, of Buffalo, N. Y., has invented a hollow rail for electric railways through which the electric wires are passed. The plan of feeding is by induction. Two tubes under one of the tracks carry the feed wires, and the power reaches the wheels and the motors through one track, coming back through the other to form the circuit.

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Formerly, WESTERN MACHINIST.

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THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, AUGUST 15, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

ELECTRIC SUBURBAN TRAINS.

Long distance electric railways are proving a great success in every instance. One electric power station can easily operate with moderate grade thirty to forty miles of track equipped with sixty to eighty cars. Steam railways are not adapted to suburban short stops; too much time and expense is required for a stop and start with steam propulsion and air-braking. Many of the steam railway lines will not touch suburban traffic or short distance runs, be it ever so well patronized, at rates on which electric lines flourish. The L. S. & M. S. Ry. may be cited as an instance. Never has it been known to accommodate the suburban public in the vicinity of large towns at all hours of the day. It never goes beyond an "accommodation" (?) or two during the whole day. It gives nothing less in rate than three cents a mile on single trips, and five to ten cents a mile if the distance is only one to three miles. In order to secure fifty cent rates for a run of twenty miles or 25 cent rates for a run of ten miles, a thousand mile ticket must be bought and used in one year. In order to secure 20 cent rates on a trip of twenty miles or 15 cent rates on a run of fifteen miles, a fifty-four trip ticket must be used inside of thirty days, which spoils on one's hands in case of sickness or accident. The result of this is that the whole Lake Shore country, which is almost one unbroken city from Buffalo to Toledo, is stagnant under the paralyzing influence of this corporation, which virtually controls the whole passenger traffic. We say the whole of it because the original enterprising designs of the N. Y. C. & St. L. Ry. management have been throttled by absorption in a manner well known to everybody.

An Electric Air-Line Railway Co. has been organized to operate an electric railway from Chicago East at least as far as Edinburg, Michigan, known as the Chicago & St. Louis Air-Line Ry. Co. They are to operate cars on their road, not only at a greater rate of speed, but for better accommodation of the public than any now in that section. We have no doubt the plan will be executed with success. And there are localities, like the country along the Lake Shore in Ohio, which are much more advantageous to the success of an electric line than the one in question. This country is almost as level as a prairie and well adapted for easy and cheap operation of electric lines. The L. S. & M. S. Ry. is making of this land a tramping ground or passage way for its trains, which stop only for coal and water, so far as local traffic or accommodation is concerned. The penurious and independent policy of its management has become a bore to this thickly populated country, than which there is no other so ignored and neglected. Even the Wilkesbarre and Scranton (Pa.) coal districts can show no greater population than the level lands of the South shore of Lake Erie, and yet four roads for that poor population run each an average of a local train every hour, making an aggregate of one train every fifteen minutes with street car accommodation rates. Many other instances could be cited, but it is not necessary. What do we receive on the Lake Shore? Local trains from six to twelve hours apart, between trains, the inhabitants being compelled to use horse and buggy, walk, or stay at home.

May deliverance come by electricity and may this Lake Shore valley be equipped its full length, with a road of modern build that will give twenty-mile ride for ten to fifteen cents for single trips, and a chance t get to business every ten minutes. Then we shall see the people stir; ther we shall see the value of real estate double, and triple and quadruple and then we shall see elegant mansions and beautiful homes in the no unattractive localities. In short, we shall see life on the Lake Shore pleasure and a profit. Let not the people wait on Providence, but take th matter in hand and act without delay. If Vanderbilt says, "the people b damned," let the people say, "the L. S. & M. S. Ry. be damned," an then go to work with a will to sweep its local traffic to the winds, and mak it the through freight road to which its inflexible management, its heav trains and its hard coaches are all adapted. This can be done easily an quickly by electricity and with comparatively moderate capital invested Plenty of capital is waiting for employment. Let it be used in this ente prise, which is sure to return good dividends

HINTS TO ENGINEERS.—XII.

BY EDWIN WOODWARD.

Allusion was previously made to the fact that lead given an engine wa not, in practice, the same at both ends. The lead should be in excess a the crank end, for from that end the piston rod extends and lessens th piston area by the amount of its own, and to make the pressure equal a both ends, it should be there admitted in a larger volume. And then th steam is much more effectively used on the forward stroke. This is not du to the fact alone that the piston receives pressure over its full area, but als because of the angularity of the connecting rod, which makes the pisto travel faster on that part of the stroke. In Fig. 10 it is exemplified. Th piston travel from *x* to *x* is laid out at the cross head. The connection *a* is on the dead center and the piston at the beginning of its stroke. Whe the crank has made one-eighth of a revolution the rod is at *b b*, and th piston has traveled over one-sixth of its distance. On the upper quarter *c c*, the piston is seen to have made over half of its journey, and when th crank has made three-eighths of a revolution, the piston has traveled abou seven-eighths of its course, then it will be observed that for the crank trave from *d* to *d'*—one-fourth of a revolution—the piston travels from *d* to *e*—one eighth—and back only. Thus it will be seen that for the first part of th revolution the piston is rapidly advancing and pushing the crank along while for the beginning of the return stroke it is correspondingly tardy—the piston being comparatively inert, seeming to rely on the momentum the fly wheel to carry it over that weak point and start it moving bac again. To overcome this defect, and to carry the crank safely above th center at *a* again, the valve is often given a little more lead at that end. is readily observed that an engine running under, *i. e.*, in the opposit way from the figure, seldom stops on the center—in starting from an i sufficient amount of steam—and the reason is that its greatest impulse given in such a way that it aids the crank to pass above the center, in plac of holding in check.

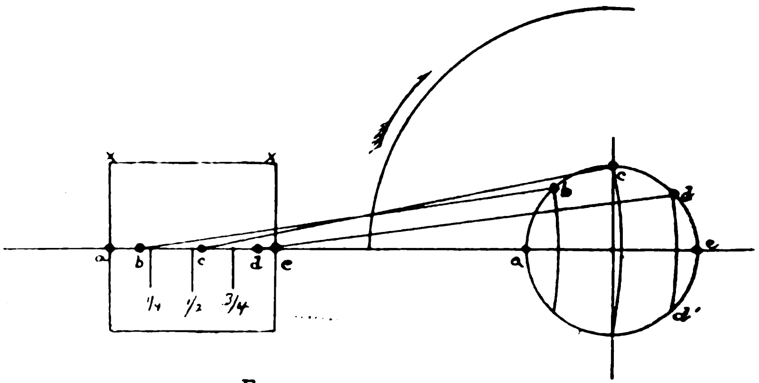


Fig. 10.

This should not be conceived as advocating running an engine unde not because it will not run as well, but because it is more difficult to kee the top guide bars lubricated than the bottom ones, although in many othe ways decided advantages are apparent. In setting a valve the cross hea joints and rod connections should be good working fit, else the lost motio may deceive as to clearance. To overcome this many engineers turn th wheel over beyond the place and by turning back tighten the joints. Thi should not be done, for by so doing the joints in the valve gear are a stacked back and consequently do not indicate their true working pos tion, as they then are all snugly together, while at work the motion is a ways straight ahead and the valve against the opposite collar.

The ordinary slide valve as generally built is usually given about one tenth the steam port width lead. However, some are given more an others much less. In setting a valve with a link, the operation is pract cally the same. The first operation should be to place the lever in the fo ward notch of the quadrant, and then getting the proper travel of the valv by lengthening or shortening the eccentric rod as the need is, then by shif ing the lever back as in reversing, find the length of that rod in the sa manner. Do not alter the valve rod to correct one rod after the other right, as this would make the right one wrong.

Then, when the valve travel is right, place the engine on the cent as before directed, and with the lever in the forward notch, turn the ward eccentric ahead till the valve is in the right place and fasten it. Pl the reverse lever in the back notch of the quadrant, then turn the backw centric in the opposite direction till the port opens to suit and the opera- on is performed.

Often one eccentric slips while the other is not disturbed and it is often esirable to reset it without taking the cover off the steam chest. It is ac- mplished by placing the engine on the center and marking the valve rod y convenient distance from the steam chest when the eccentric that is ght is in operation, then to reverse the lever and turn the eccentric that s slipped in the direction it is to run till the mark on the rod comes the me distance from the steam chest.

Often the eccentric slips and it is inexpedient or expensive to take the cessary time to set it in the usual way, and the engine must go ahead with ry little delay. Place the engine on the center as nearly as the eye will tect, then after opening the throttle slightly, turn the eccentric ahead till e valve uncovers the port sufficiently for steam to issue from the cylinder ck at the end the piston is in. The engine may then be depended on for ime till the proper setting may be made.

It frequently occurs that it is desirable to reverse a plain engine, and coure having no link to shift, the operation must be performed by shift- g the eccentric. Usually the operation, as regards time consumed, is uivalent to the setting of a valve, as similar tactics are mostly adopted. can be very quickly done by placing the engine on the center and mak- g a prick mark on the valve rod, as before explained, a certain distance m the steam chest or coincident with another on the valve slide guides; en by loosening the eccentric and turning it in the direction it must travel l the marks are in line again, the aim is easily and surely accomplished. o knowledge is so distictly valuable as that which is the outgrowth of me embarassing dilemma, and a dilemma met and vanquished is more luable for the lesson it teaches than months of uninterrupted monotony, d it should ever be the aim to be on the alert for these exigencies and anning, should any difficulty befall, the most reasonable and logical solu- n of the problem.

The idea of schooling the mind to meet the real, by demolishing imag- ary difficulty, has a beneficial effect and gives its possessor a confidence d ability to do, that is in marked contrast with the helpless incompetent at shovels coal under your neighbor's boiler and "starts" and "stops" e engine. Every engineer should know how to right his engine if an centric slips, or the wear of the brasses reduces the clearance to naught, c., etc., all of which is readily determined if his engine is trammed, and at useful branch will be made plain to the youngest learner, if moderate ttention is given.

MARS AND ITS LIKENESS TO THE EARTH.

BY F. D. LESLIE.

Mars is one of a group of planets to which the Earth belongs. There e two groups of planets in the solar system. The first is the one alluded , consisting of Mercury, Venus, the Earth and Mars. These planets are istant from the sun in the order in which they are given, Mercury being e nearest. This is the group of small planets, the Earth being the largest the four, and it is much nearer the sun than the group of large planets, nsisting of Jupiter, Saturn, Uranus and Neptune. The orbit of Neptune escribes the utmost limits of the solar system.

Of the four in the group of small planets, the Earth is the largest and ars next. The latter planet has, ever since the invention of the telescope abled scientists to survey the heavens, been the most interesting, as it resents a favorable view to the astronomer, whose examinations of it are ery satisfactory and fruitful of results, in discovery. Just at this time, or uring the past few weeks, Mars has occupied a position in the universe nusually advantageous for telescopic inspection. This is because it has en near the earth, its minimum distance from our planet being 33,800,000 iles, and its maximum distance 61,800,000 miles.

But there is another reason why astronomers and scientists in general ve devoted so much time to the study of the planet. The powerful in- ruments which have acquainted us with the heavenly bodies, their relations each other and with the universe, have enabled man to discover no dy as analogous to our Earth as this one. Its position, distance from the n, density and its terrestrial and surface conditions, so far as we now now, show it to be of all the planets most like the globe on which we live.

The inquiry whether beings akin to man exist on the heavenly bodies ible to the naked eye is not confined to civilized races, but has been nceived in the minds of savages. The writer remembers having been ked this question in upper Michigan by a young Chippewa Indian, who d probably never before been in contact with whites more intelligent than rder natives. It seems to be of instinctive origin. If any other world n ours is inhabited by beings possessed of knowing minds, so far as our formation goes, it must be Mars. The resons for this conclusion may be viewed as follows: For the maintenance of animal life, even much ferent from the forms we are acquainted with, it is reasonable to suppose t there must be vegetable life. It is true that the atmosphere has much do with the propagation of vegetation, but a soil similar to our, it is fair presume, is necessary for its existence. Therefore the nature of the terial of which the planets are composed must be taken into considera- n, in judging whether there is such a soil on any of them, as well as the stence of a proper atmosphere surrounding them. Many, in this day, of the opinion that the distance of a planet from the sun does not deter- ne the degree of heat on its surface as much as the atmospheric conditions. is stated by some authors that Mercury is too calorific, on account of its arness to the sun, for the existence of life, while Neptune can have none cause its great distance from the bright orb renders it excessively frigid. e theory is held by not a few that the emanation from the sun called ht is not caloric radiation as much as formerly supposed, and that t energy is produced by it only in combination with the element called osphere. If this be true the face of Mercury might be as cold as the rth pole and the surface of Neptune baked and scorched with heat.

But the specific gravity of the various planets enable us to judge whether there can exist upon their surfaces soil in which it would be possible for vegetable matter to take root and grow. It does not appear reasonable that soil favorable for the birth of life can be found on a planet whose substance is lighter than cork, as is that of Saturn, nor on one heavier than iron, as in the case of Mercury, although the probability would be more in favor of such a condition on Mercury than on Saturn. The specific gravity of the planets ranges from eight times that of water, the weight of Mercury, to seven-tenths that of water, the weight of Saturn. The Earth weighs about five and a half times as much as water of equal bulk, while Jupiter is but little lighter than water. Venus and Mars are nearly the same density as the Earth. We therefore see that Mars is very much like the Earth, and the conditions must be favorable to the maintenance of a race of human beings. Its size is much smaller, its diameter being about 4,400 miles, while that of the Earth is 7,916.17 miles, and its years, measured as ours are, an entire circuit around the sun completing one, are of 687 days duration, more than twice as long as the Earth's year, its days being only about forty minutes longer than our days.

It is for these reasons that Mars is scrutinized so carefully. It has been discovered that it has polar and equatorial regions, and some astronomers assert that it has large areas of water, while others believe that certain indications point to a number of great canals. The observations of Mars during the past few weeks have added greatly to our information concerning its physical conditions. The most advantageous view was procured from Peru, where Prof. Pickering was sent by Harvard University for the purpose of examining the planet. The following dispatch was received from him a few days ago:

"In my observation of Mars I have seen two large areas near the equator which are permanently blue. Near the edges they appear light. The total size of the area is about 500,000 square miles, one half the size of the Mediterranean sea.

"On June 23 a small dark spot appeared in the southern snow cap. Later this spot lengthened rapidly and early in July it was a thousand miles long, dividing the snow in half.

"Six hundred thousand square miles of snow have melted within the last 30 days. The melted snow has apparently been transferred to the seas across land.

"Small, dark areas, surrounded by snow, appeared on July 10, and two days later I first saw a dark line in the fork of a Y-shaped mark in the direction of the sea. The line became more conspicuous on July 14, and on July 16 a dark area about the size of Lake Erie appeared on the northern side of the stem of the Y, which was connected with the northern sea. The next day there appeared a large, dark gray area near the northern sea.

"This had grown much fainter by July 23, and a new area appeared to the south of the northern sea, concealing its outline. The line in the fork of the Y had disappeared, but area of the Y had extended. On July 24 a large, dark area, apparently either a lake or sea, appeared near the melting snow, and on July 25, the southern branch of the Y became very narrow. The outlines of the northern sea were seen again, a narrow white line stretching north.

"Many other changes were noted. Rapidly changing, faint whitish areas were seen. Green areas near the poles have not been seen for many weeks, but traces were recently suspected, and a bright green area was distinctly seen near the north pole last night."

There are many theories extant regarding the probability of a race of human beings residing on any of the planets, but however learned it may be, none can rise above hypothesis.

The writer is able to discover no reasonable grounds for denying that the conditions, physical and otherwise, of Mars are such as to promote vegetable and animal fructification. It is therefore quite probable, if we entertain the reasonable belief that nothing in nature exists without a purpose, that vegetable, animal and human life analogous to ours, is possessed by Mars.

Water Ram in Steam Pipes.

Under the head "Steam Pumps," in this issue, will be found a reference to what is known as the water hammer. In connection with this, the following may prove interesting:

If steam be introduced below the surface of water contained in a large vessel, a bubble will be formed which will increase in size until its surface becomes sufficiently extended to condense the steam more rapidly than it can enter, when a partial vacuum will be created, the bubble will collapse, and the water, flowing in from all sides at a high velocity, will meet with a blow forming what is called a water ram.

Such explosions occurring in the middle of the mass creates simply a series of sharp noises. But if steam be blown into a large inclined pipe full of water, it will rise by difference of gravity to the top of the pipe in the form of a bubble; and when condensation takes place, the water below the bubble will rush up to fill the vacuum, giving a blow directly against the side of the pipe. As the water recedes the bubble gets larger, and moves farther and farther up the pipe, the blow each time increasing in intensity, because the steam has passed a larger mass of water, which is forced forward by the incoming steam to fill the vacuum.

The maximum effect generally occurs at a closed end. Even if the water does not originally extend to the end of the pipe, if this be filled with steam which has bubbled through water on its way to that point, there may be sufficient cold metal to condense it; and when collapse takes place the whole mass of water in the pipe is driven against the end, sometimes with sufficient force to rupture it.

A dangerous water ram may be produced in a pipe filled with water, even if the end be open, should the pipe be crowned upward at any part of its length. A bubble will form at the top of the crown, and there collapsing, water will be forced in by atmospheric pressure from one end and by steam pressure from the other, and the meeting of the two columns may rupture the pipe. The same action can occur in a level pipe, but not in one which descends away from the entering steam, so that the latter is always above the water.

MECHANICAL MELANGE.

An engine lathe fitted with an inside face plate will be found to be a valuable accessory in every shop where much tool work is to be done. Take the ordinary large face plate of the lathe; make a cast-iron disk the same size as that face plate and about 5 per cent. of the diameter in thickness—that is, 1" thick to 20" in diameter—and carefully drill three or four holes at regular intervals through both, near the circumference, they being clamped together for this purpose. Into these holes in the face plate fit studs, or posts, to extend outward, perhaps 8" on their bodies in addition to the shanks that are fitted to this plate. These shanks may be 1" in diameter, long enough to pass through the plate and be fastened behind by nuts and washers. The body of the studs may be 2" in diameter, and they must be drilled and tapped in the outer ends. These studs on their outer ends must be faced carefully in position, so that the inner face of the disk shall run dead true when it is fastened in place. This disk is secured to the studs by carefully fitted cap screws and dowel pins and its circumference is turned to exact truth after it is attached to place. Then, in the middle of this disk a suitably-sized hole is to be bored to work through. Within this inside face plate all manner of boring and facing operations may be done. The work may partly be attached to the original face plate, to the disk, an intermediate angle plate, or all of these. The saving in time of rigging up, and the rigidity of hold will be found to be great and will be appreciated by both the workman and the manager. With this fixture there seldom is need of the angle plate and when a counterweight is needed it can be attached precisely where it will do its work best.

A little clear study will convince every engineer that diametral pitch is the best theoretical as well as the simplest practical scheme for calculating the sizes of gears. It is obvious that circumferential pitch is only another term for the diametral pitch, because the ratio 3.1416 between these two elements of the circle is a constant. What is usually called the circular pitch, however, if it is not proportionate to diametral pitch, is the chordal pitch, because it is usually laid out as a polygon within the pitch-line by the dividers. This is ordinarily the most practical method to indicate the distance between teeth for pattern-makers who do not, as a rule, have mechanical means for spacing the circle proportionately to the length of its circumference; and they are thus obliged to inscribe within the pitch-line a polygon with double as many sides as the number of teeth they require. The fact in relation to diametrical pitch that disturbs a person taking a superficial view of the pitch problem is that a space or tooth on a diametral pinion having eight teeth has a chord about .025 shorter than a corresponding chord on a gear of the same pitch which has one hundred teeth; and gears having other numbers of teeth vary in a proportionate degree. This at first looks as if the action of that pinion with eight teeth in that gear with one hundred teeth would be decidedly bad. But it must be borne in mind that gear wheels should not move differentially as polygons but regularly as circles. The pitch-lines of two meshed gears are in actual *material* contact but an instant of motion as each tooth of one gear passes through one of the spaces in the other. Consequently they are not more the driving points than other contiguous points of the blades of the teeth. Again, the chord of the pitch-line of the immeshed tooth can never be co-incident with the chord of the pitch-line of the space it occupies. Hence the pitch-chord of a tooth cannot be an item of any importance in designing it. The whole matter is made clear when it is stated that the driven wheel must move with as regular a motion as the driver has, that is, the pitch-line in each must move forward an equal number of the same units of motion in each unit of time; and the blades of the teeth on each gear should be so shaped that they, acting on the pitch-line of the teeth in the other gear, shall give that result. This necessitates that the length of the pitch-line should always be exactly proportionate to the quantity of teeth so that the pitch-arc in each tooth and space shall be of the same length in one gear of the same pitch as in another. Hence, the pitch-line being a circle, it follows that the quantity of teeth will also be proportionate to the length of the diameter if they are proportionate to the length of the circumference.

Sometimes an improved means supersedes an old practice, part of which old practice is superior to the corresponding part of the new one. Thus the use of emery cloth has largely superseded the use of the pointed pine stick charged with oil and emery for lathe polishing both iron and steel, because the emery cloth is handier. Now, while this emery cloth is an admirable help in lathe polishing, it has limits and defects. Its limits are the impracticability of operating it within sharp angles, or deep within any angle—and the tendency to brighten high elevation to a greater degree than lower ones. Its defects are its tendency to scour off sharp corners, to remove too much material by abrasion where it should only burnish; and by filling up with metal and scratching the work. Added to these is the temptation to the workman to neglect to finish with oil and thus invite rust. With the old-fashioned soft pine stick dipped in mixed oil and emery, and served vigorously with elbow grease and a reasonable speed, a polish can be got that cannot be approached for color or for uniformity by the use of emery cloth.

If a machinist be given the remnant of a broken gear that contains the hub and two teeth only, he should be able to determine every element of the whole wheel. The pitch (diametral) may be found very easily by one of three methods: First, if the gear be properly made the thickness of the point of a tooth will indicate the pitch. Thus an 8 P. tooth is or should be very close, one-eighth of an inch thick at the point; and other pitches of correctly made gears obey the same rule of the comparative equality of their points to the signatures of their pitches. Hence those fractions of the whole circumference which remain on the points of all the teeth of a gear, after it is cut, would, if added together approximately, equal in length the pitch diameter. Second, the depth of the space from the circumference in a gear is or should be about 2.16 of the pitch, thus a 10 P. gear will have spaces about 2.16" deep, and a 6 P. about 3.6" deep. Divide 2.16 by the full depth of the space in inches, and the result should approximately be the pitch. Third, and most reliable method, measure a chord from the side of one tooth, across that tooth and across the space to a corresponding point on the next tooth, on the pitch-line as nearly as can be guesseed, and one-third of this chord will be approximately the diametral pitch. A fractional pitch is not used as a rule except with very coarse teeth; and therefore when the approximate pitch is found the true pitch can be determined with practical certainty. Thus with the first rule, the point of a tooth may be considerably less than .12" or more than .13", and there should be no reasonable doubt that in either case the gear is 8 P. Therefore, with the second rule, the space may be anywhere between .21" and .22" and always indicate 10 P. And hence with the third rule, the length of the chord may be between .49" and .53", and the inspector may be positive that it is 6 P. and not 5½ P. nor. 6½ P. When, therefore, in the case of the broken fragment of a gear, the pitch is thus obtained, then all that is problematical is found. If the hub is present the radius can easily be got, and when both the radius and the pitch are known the getting of the diameter and the whole number of teeth are of the simplest kind of problems.

The designer of tools must be correct in his deductions or his work is a failure. In no department of the human industry is it so necessary to be right as in the initial creation of pieces of metal that are to be assembled together as a machine to do a specific operation. In an essay, or an argument, it is only necessary to convince the reasoning faculties of an audience or an individual that theories are right; or the better ones. This is also true of the drawings for machinery, which often will satisfy the most critical of inspectors, while the machine made from them may absolutely fail to operate, and in itself will convict both the designer and the critic. A machine either works as designed or fails, as a fact; logic cannot help it. The difficulties, however, do not exculpate the engineer who attempts to design a tool and fails. His failure is just as much a black eye for a new creation as for the adaptation of a well known device for a new use so similar to the old one that there are but few chances in the problem for the design to fail. The designer must question mentally until the thing thinks out clear. Then he must question on paper until it looks clear, and finally he must experiment in some shape until it actually is clear. Every mechanical problem a man works out helps him on each succeeding one; but the problems that the other man works out do not help in the same degree, and many problems personally worked out is what is meant by practice. Knowledge of mathematics is a necessary item in a designer's equipment, but it must be so placed in his mind that it can readily be applied to practical problems of phases differing from those used as illustrations at school. I know men who are good mathematicians provided they are not deployed from problems similar to those in their text-books; but when they are required to make new applications of their knowledge or materially to modify it to suit an abstruse problem, they are helpless as the first schoolboy in this item: He, being asked "Six girls times six oranges are how many of which?" answered "Er-thirty-six girls—er-er-oh-" "Next boy!" "Thirty-six oranges if the six girls hadn't et any of 'em." There was the timber for an engineer in that last boy.

De Gree recently attended the commencement exercises of the school that graduated him. On securing an interview with a professor who had taken an interest in him during his school years, he explained his difficulties in practical experience and asked advice, thus:

"You see, professor, it was the next May after I left here before I got a chance of any kind, and father had become so impatient that he was about to put me on the road as a brakeman when I got an introduction to Mr. Blunt and went to work for him at 12 cents an hour, beginning at 7 A. M. and stopping at 6 P. M. At the end of a year I had the princely salary of fifty dollars a month, and Mr. Blunt kept me hard at work calculating sections and areas to withstand stated strains and to hold stated contents, drawing harmonious outlines, and in everything figuring out the last ounce of superfluous metal, to his order. But when I make a suggestion to convince him that I am not a blockhead, he sits down on me so hard that I am often attempted to resign and try to get a more congenial place."

"You have been there more than four years. Does he not give you more than the sum you mentioned now?"

"Oh, yes, I get $100 a month now."

"Do you not have any title or position? I have heard you were his manager."

"I carry out his instructions, but if I attempt to do any actual management he lays me out."

"My dear boy, you have a very busy father and a very indulgent mother, so that you have been getting your first taste of what American boys are most in need of—discipline. Now, if you can persuade Mr. Blunt to take my boy Fred. who is just graduated, and make a man of him you will do me a greater favor than I have ever been able to do for you."

The true inventor has no regard for dogma; he believe he sees light ahead and moves toward it. It may be that what he sees is an *ignis fatuus* or a chimera, but he insists on discovering that for himself and he is satisfied with no theories. I recently talked with a perpetual-motion man and tried to dissuade him, being confident it would be easy to convince so intelligent a person that his scheme was not possible. But he rose above my dogmas in an instant by showing that the whole solar system is a perpetual-motion device, moving without assignable cause and not varying an instant of comparative time within the period of its recorded history. I thought of Galileo, and stopped.

If you will examine a polished cast iron surface with a strong glass you will notice that it has not a continuous metallic appearance; it will look like a web of bright metal filled in with a darker gray substance. This darker filling may be partly graphite and partly iron in an imperfectly metallic state. Now it is supposed, in soldering to a surface of this kind, that the molten metal will adhere to only the skeleton of bright iron and have no union whatever with the filling, and that this diminished surface makes the soldering difficult, and makes the joint weak after it is soldered. —[A. D. Pentz, in Engineering Magazine, under "Machine Shop Notes."

CYRUS W. FIELD.

The portrait on this page is of an American whose achievements have made him one of the most noted men of the world and will cause his fame to grow more and more as civilization and science advance.

Cyrus W. Field is the father of submarine transmission of speech by wire. Few men have combined the scientific training and the keen perception of scientific truths not before recognized with the business capacity, courage and firmness of purpose that Cyrus W. Field did. He was one of those Americans of whom we are proud, because of his distinguished manliness and splendidly good character.

His death, which occurred July 12, was mourned as few deaths are—as no Gould or Vanderbilt will be.

Cyrus West Field was born on November 30, 1819, at Stockbridge, Mass., and belonged to a remarkable family, which boasted of revolutionary heroes. His father, David Dudley Field, Sr., was a Congregational minister in Somers, Conn., where he married Submit Dickinson, whose father had fought side by side with her husband's father through the revolutionary war. Cyrus was the seventh child, his brother, Henry Martyn, a preacher of considerable ability, and his sister, Mary, being younger. David Dudley Field, who, aside from Cyrus, is the most celebrated member of this remarkable family, was the first child. Stephen J., associate justice of the United States Supreme Court, and the late Jonathan, who was president of the Massachusetts Senate, were older than Cyrus. There were two other brothers, long since dead—Matthew, a noted engineer, and Timothy, who was an officer in the United States Navy. None of these, however, it may be safely said, attained the world wide reputation of the subject of this sketch. His early training admirably fitted him for the great work which he afterward undertook and the successful completion of which entitled him to a prominent position among the leading men, not only of his own age, but of the world.

CYRUS W. FIELD.

At Stockbridge he secured a common school training and at the age of fifteen years started out for himself. Like most boys of his time he turned toward New York. He entered the establishment of A. T. Stewart at a salary of $2 per week. This was not very encouraging but the training he received at this time proved of great value to him in after life. When he first engaged in business for himself he was not successful, in fact several of his early ventures failed, but he was persistent, and his ability, earnestness and perseverance were rewarded at last.

Mr. Field had acquired considerable wealth in 1853, when he determined to retire from mercantile pursuits. After traveling for several months through South America he returned to New York, where an effort was made to enlist his influence in support of a telegraph line in Newfoundland. It was the intention of the promoters of this project to carry the line to St. Johns, where connection could be made with a fast line of steamers that, it was believed, could reach Ireland in five days. This enterprise was not accorded much encouragement as it was looked upon as a wild-cat venture. It was broached to Mr. Field and he in turn conceived the idea of the Atlantic cable. This last proposition was so much in advance of anything yet presented that it was regarded as conclusive evidence of insanity and Mr. Field was ridiculed by the so-called "conservative" element. Even after the subject had received the careful attention of scientists and engineers of this country and Europe there was division of opinion as to the practicability of the scheme, but many famous scientists and not a few capitalists encouraged the idea and assured its promoter of their support. While the project for an Atlantic cable was making but little progress there was a strong movement on foot to establish an overland telegraph by way of Alaska and Northern Russia, and this, strange though it may seem to-day, was considered far the more practicable route. No doubt this had much to do with the lack of interest in the submarine project. At any rate Mr. Field found it a herculean task to secure support of capitalists, but when once he enlisted their sympathy they never wavered in their support.

It was decided to form a stock company for the purpose of laying a cable. Peter Cooper was the first subscriber. Moses Taylor, Marshall, O. Roberts and Chandler White, were also co-laborers in this undertaking. Concessions were obtained from the Newfoundland Legislature, and on May 6, 1854, the New York, Newfoundland & London Telegraph company was formed. Messrs. Cooper, Taylor, Field, Roberts, and White were named directors. Mr. Cooper was chosen president, Mr. White vice president, and Mr. Taylor secretary. A capital of $1,500,000 was subscribed on the spot, of which Mr. Field contributed $200,000 in cash. At this time the work was taken up and pushed with vigor. The line from New York to St. Johns was completed in a year, but this work cost more than a million dollars and the projectors of the enterprise were obliged to seek assistance. The United States and Great Britain aided materially. Both governments were induced to organize expeditions, and the surveys established the validity of the theory beyond question. The directors persuaded Mr. Field to go to Europe and ask financial aid. In the summer of 1856, Mr. Field induced the English government to furnish ships for soundings and for laying a cable, and to pay the company an annual subsidy of at least fourteen thousand pounds for government messages. Mr. Field next organized a company with a capital of £350,000, of which he subscribed one-fourth. It was known as the Atlantic Telegraph Co. Mr. Field met much more opposition at Washington than at London, and it was only after a determined contest that he received government aid. The first attempt to lay the cable, which was made in 1857, proved a failure and greatly discouraged many who had been interested in the project. This could not be said of the man most interested. He never despaired, in fact, each failure or disappointment served to spur him on to even greater efforts. He was apparently a man of wonderful resources and great energy, and it was well that he possessed these qualities, for one with less courage or with a less hopeful disposition, must necessarily have abandoned the enterprise. While these unsuccessful attempts were being made to lay the cable, Mr. Field's faith in the ultimate success of the project never faltered; he was confident while all around him were disappointed and disgusted.

When his persistence had begun to tire his friends, success came, and Mr. Field's scheme, which had been termed the freak of a disordered brain, became a reality. The successful expedition started from Valentia, Ireland, July 13, 1866. The Great Eastern, which carried the cable, arrived at the harbor of Heart's Content on July 27th, but as the Newfoundland cable was not completed there was a delay of two days. On the morning of Sunday, July 29th, the people of New York city received through the *New York Herald* the announcement that "the cable is laid and in perfect working order," which had been telegraphed by Mr. Field on his arrival at Heart's Content. The news was received with rejoicing, but even at that time the people did not fully realize the importance of this great work.

With success came honors and acknowledgments from the government and scientific bodies. Congress bestowed a gold medal upon Mr. Field and voted him the thanks of the nation. The grand medal of the Paris Exposition was also awarded him in 1867.

In reviewing Mr. Field's work, James D. Reid, in his admirable history of "The Telegraph in America," says that the credit is universally ascribed to Mr. Field. "It is one of the honors alike unquestionable and unquestioned," according to this authority. "Neither is it overstating the importance of the successful laying of the Atlantic cable if it be claimed that no gift of science or manly courage has to such a degree dignified and unified the civilization of the world, or given like life, seope and value to its commerce."

Mr. Field's public work did not end with the laying of the great cable. In 1877 he became interested in the old New York Elevated Railway Co., controlling valuable franchises but up to that time accomplishing absolutely nothing in the way of furnishing rapid transit. For ten years he controlled this great enterprise and in that time the value of the stock advanced from $14 per share to $172. When in 1887 Mr. Field retired from this enterprise he withdrew to private life and did not figure again in public affairs. He was beloved and respected by all, and in his declining years had many devoted friends.

The portrait here presented is furnished by the *Western Electrician.*

A Novel Unsinkable Yacht.

A Leith, Scotland, boatbuildr is constructing a yacht which, in regard to design and material, is probably unique. This builder is the patentee of a boat which he claims is unsinkable and uncapsizable. Hitherto he has constructed them of steel, and he claims that owing to the manner in which the fore and aft sections, which are conical in shape, are permanently and hermetically sealed, the boats are rendered unsinkable, even if filled with water, as the water runs back into the sea through the opening in the center-board casing. The cruising yacht he is about to build will not be of steel, however, but of an aluminum alloy. The metal is as white as silver and possesses a breaking strain of twenty-four tons to the square inch. It is unaffected by water. The yacht, which instead of being painted will be polished, will be about thirty-two feet long and eight feet broad, and will be provided with a roomy cabin paneled in oak and a commodious forecastle. And the deck fittings, as well as a center-board dingey which will accompany the yacht, will be made of the same white metal. If this experiment should turn out successfully, a new departure in yacht construction and fitt beings may expected.

THE DEVELOPMENT OF THE STEAM-ENGINE.—VI.

BY PROF. R. H. THURSTON.

[Continued from the issue of Feb. 15th, 1892.]

The Locomotive.

The locomotive was one of the fruits of the inventive genius of Watt and his contemporaries. When the steam engine had so far been perfected that the possibility of its application to other purposes than the elevation of water had become generally recognized, the problem of its adoptation to the propulsion of carriages was attacked by many engineers and inventors.

As early as 1859 Dr. Robinson called the attention of Watt to the possibility of constructing a carriage to be driven by a steam engine. Watt, at a very early period, proposed to apply his engine to locomotion, and contemplated using either a non-condensing engine or an air surface condenser. He included the locomotive-engine in his patent of 1784, and his assistant, Murdoch, in the same year made a working-model locomotive which was capable of running at a rapid rate.

The first actual experiment was made, as is supposed, by a French army officer, Nicolas Joseph Cugnot, who in 1769 built a steam-carriage, which was set at work in presence of the French Minister of War, the Duc de Choiseul. The funds required were furnished by the Comte de Saxe. Encouraged by the partial success of the first locomotive, Cugnot, in 1770, constructed a second, which is still preserved in the Conservatoire des Arts et Metiers Paris. This more powerful carriage was fitted with two non-condensing single-acting cylinders 13" in diameter. Although the experiment seems to have been successful, there appears to have been nothing more done with it.

An American of considerable distinction, Nathan Read, patented a steam-carriage, 1790.

In 1804 Oliver Evans completed a flat-bottomed boat to be used at the Philadelphia docks, and, mounting it upon wheels, drew it by its own steam-engine to the river-bank. Launching the craft, he propelled it down the river, using its steam-engine to drive its paddle-wheels. Evans's "*oructor amphibolis*," as he named the machine, was the first road-locomotive that we find described after Cugnot's time. Evans asserted that carriages propelled by steam would soon be in common use; and offered a wager of $300 that he could build a "steam wagon" that should excel in speed the swiftest horse that could be matched against it.

Trevithick and Vivian built a locomotive-engine in 1804 (Fig. 11) for the railway at Merthyr-Tydvil, in South Wales, which was quite successful, although sometimes giving trouble by slipping its wheels. This engine had one steam-cylinder 4¾" diameter, and carried 40 pounds steam.

Colonel John Stevens, of Hoboken, was undoubtedly the greatest engineer and naval architect living at the beginning of the present century. Without having made any one superlatively great improvement in the mechanism of the steam-engine, like that which gave Watt his fame; without having the honor of being the first to propose navigation by steam, or steam transportation on land, he exhibited a far better knowledge of the science and of the art of engineering than any man of his time, and he entertained and urged more advanced opinions and more statesmanlike views, in relation to the economical importance of the improvement of the steam-engine, both on land and water, than seem to have been attributable to any other leading engineer of that time.

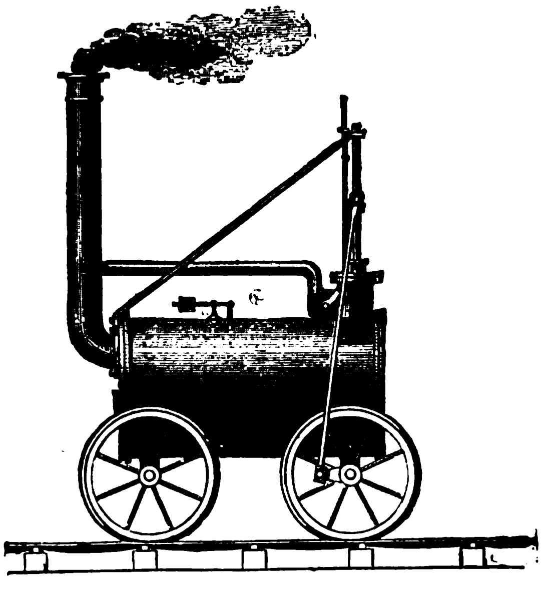


FIG. 11.—TREVITHICK'S LOCOMOTIVE, 1804.

In 1812 he published a pamphlet embodying "Documents tending to prove the Superior Advantages of Railways and Steam-carriages over Canal Navigation." At this time the only working locomotive in the world was that of Trevithick and Vivian, at Merthyr-Tydvil, and the railtroad itself had not grown beyond the old wooden tram-roads of the collieries. Yet Colonel Stevens says in this paper: "I can see nothing to hinder a steam-carriage moving on its ways with a velocity of one hundred miles an hour"—adding in a footnote: "This astonishing velocity is considered here merely possible. It is probable that it may not, in practice, be convenient to exceed twenty or thirty miles per hour. Actual experiments can only determine this matter, and I should not be surprised at seeing steam-carriages propelled at the rate of forty or fifty miles an hour."

He proposed rails of timber, protected when necessary by iron plates, or to be made wholly of iron. The car-wheels were to be of cast iron, with inside flanges to keep them on the track. The steam-engine was to be driven by steam of fifty pounds pressure and to be non-condensing.

He gives 500 to 1,000 pounds as the maximum weight to be placed on each wheel, shows that the trains—or "suites of carriages," as he calls them—will make their journeys "with as much certainty and celerity in the darkest night as in the light of day," shows that the grades of proposed roads would offer but little resistance, and places the whole subject before the public with accuracy of statement and evident appreciation of its true value.

In 1814 George Stephenson, to whom is generally accorded the honor of having first made the locomotive-engine a success, built his first engine at Killingworth, England.

In 1815 he applied the blast-pipe in the chimney, by which the puff of the exhaust steam is made useful in intensifying the draught, and applied it successfully to his second locomotive, here seen in section (Fig. 12). This is the essential characteristic of the locomotive-engine. In 1815, therefore, the modern locomotive steam-engine came into existence, for it is this invention of the blast-pipe that gives it its life, and it is the mechanical adaptation of this and of the other organs of the steam-engine to locomotion that gives George Stephenson his greatest claim to distinction.

In 1825 the Stockton and Darlington Railroad was opened, and one of Stevenson's locomotives, in which he employed his "steam-blast," was successfully used, drawing passenger as well as coal trains. Stephenson had at this time become engineer of the road. The time required to travel the distance of twelve miles was two hours.

One of the most important and interesting occasions in the history of the application of the non-condensing steam-engine to railroads, as well as in the life of Stephenson, was the opening of the Liverpool and Manchester Railroad in the year 1829. When this road was built, it was determined, after long and earnest discussion, to try whether locomotive-engines might not be used to the exclusion of horses, and a prize of £500 was offered for the best that should be presented at a date which was finally settled at the 6th of October, 1829. Four engines competed, and the "Rocket," built by Stephenson, received the prize.

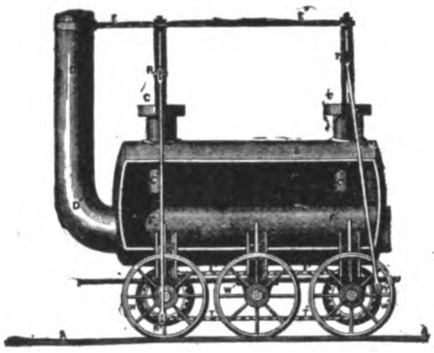


FIG. 12.—STEVENSON'S LOCOMOTIVE, 1815.

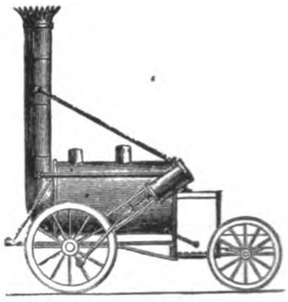


FIG. 13.—THE ROCKET, 1829.

This engine (Fig. 13) weighed four and one-fourth tons, with its supply of water. Its boiler was of the fire-tubular type, a form that had grown into shape in the hands of several inventors, and was three feet in diameter, six feet long, with twenty-five three-inch tubes, extending from end to end of the boiler. The steam-blast was carefully adjusted by experiment, to give the best effect. Steam pressure was carried at fifty pounds per square inch.

The average speed of the Rocket on its trial was fifteen miles per hour, and its maximum was nearly double that, twenty-nine miles an hour; and afterward, running alone, it reached a speed of thirty-five miles.

In America the locomotive was set at regular work on railroads, for the first time, on the 8th of August, 1829. This first locomotive was built by Foster, Rastrick & Co., at Stourbridge, England, and was purchased by Mr. Horatio Allen for the Delaware & Hudson Canal Co.'s road from Carbondale to Honesdale, Pennsylvania.

It was at about this time (1831) that Mr. Horatio Allen introduced the first eight-wheeled locomotives ever built, and gave them a form which was the prototype of a recently-built locomotive which has been brought out in Great Britain. In this year, also, an engine, the De Witt Clinton, was built for John B. Jervis of the Mohawk and Hudson Railroad. At about the time of the opening of the early railroads, the introduction of steam-carriages on the common highway had become a favorite idea with engineers.

In December, 1833, about twenty steam-carriages and traction road-engines were running or were in course of construction in and near London.

In our own country the roughness of roads discouraged inventors, and in Great Britain, even, the successful introduction of road-locomotives, which seemed at one time almost an accomplished fact, finally met with so many obstacles that even Hancock and Gurney, the most ingenious, persistent, and successful of constructors, gave up in despair. Hostile legislation procured by opposing interests, and possibly also the rapid progress of steam-locomotion on railroads, caused this result.

The steam-blast of Hackworth, the tubular boiler of Seguin, and the link-motion of Stephenson constitute the essential features of the modern locomotive-engine. Locomotives have gradually and steadily increased in size and power from the date of their introduction. The Rocket, which first proved conclusively, in 1829, the value of steam-locomotion, weighed 4¼ tons. In 1835 Robert Stephenson, who had coustructed it with his father, writing to Robert L. Stevens, said that he was making his engines heavier and heavier, and that the engine of which he enclosed a sketch weighed nine tons, and could draw "100 tons at the rate of sixteen miles an hour, on a level." Locomotives are now built weighing seventy tons, and even one hundred, and powerful enough to draw more than 2,000 tons at a speed of twenty miles an hour. The modern locomotive consists of a boiler, mounted upon a strong light frame of forged iron, by which it is connected with the wheels. The largest engine yet constructed in the United States is said to have a weight of about 200,000 pounds, which is carried on twelve driving wheels. A locomotive has two steam-cylinders, either side by side within the frame, and immediately beneath the forward end of the boiler, or on each side and exterior to the frame. The engines are non-condensing and of the simplest possible construction. The whole machine is carried upon strong but flexible steel springs. The steam pressure is usually more than a hundred pounds. The pulling-power is generally about one-fifth the weight under most favorable conditions, but becomes as low as one-tenth on wet rails. The fuel employed is wood in new countries, coke in bituminous-coal districts, and anthracite coal in the eastern part of the United States. The general arrangement and the proportions of locomotives differ somewhat in different localities, as will be seen later.

The common three-ported slide-valve was invented by Murdoch, while with Watt, about 1799. This valve, driven by a system of single loose eccentrics and stops, for either forward or backward gear, was adopted by Stephenson and others, and probably by some of the first builders of the marine engine, as well as on the locomotive, as early as or earlier than 1820. At about this latter date the heart-shaped cam and its frame came into temporary use, to be superseded in 1840 or 1842 by the so-called Stephenson link. The two eccentrics, for forward and backward motion, with their hooks and the wedge-motion, were also in use during this period, the hooks being the favorite arrangement, towards its close, on locomotives. The link continues in use as, on the whole, the most satisfactory gear, although, since 1855-60, many modifications and the later class of "radial" gears have been brought into competition with it.

After their introduction, the growth of railroads and the use of locomotives extended in the United States and in Europe with great rapidity. The first railroad in the United States was built near Quincy, Mass., in 1826. In 1850 there were about 700 miles in operation; in 1860 there were over 30,000, and in 1890 about 160,000 miles of completed road in the United States; and the rate of increase has risen in 1873 to above 7,000 miles per year, as a maximum, and the consumption of rails for renewal alone amounts to probably a million tons per year.—[From "A Manual of the Steam Engine," by R. H. Thurston: J. Wiley & Sons, New York.

Practical Letters.

The Four Tanks.

EDITOR SCIENTIFIC MACHINIST:

Answer to question 409 "W. M. B.," Pratt, Minn., under the heading of "Questions and Answers," in August 1 issue of the SCIENTIFIC MACHINIST, does not appear satisfactory to my understanding of the hydraulic effect of water in a vessel.

The bottom area of all water-containing vessels must sustain a pressure per square inch equal to the extreme elevation of their water contents, regardless of quantity, water being susceptible of a flowing or distributing effect. Consequently, contraction of the top diameter, while it might diminish the quantity of water, would not lessen the effective pressure upon the bottom surface, or vice versa. Widening the top would increase the volume of water but not the elevation nor affect the bottom pressure, the inverted cone sustaining the surplus.

A perpendicular tube attached to the bottom of either vessel would unquestionably represent an equal flow. J. C. B.

[We stated in substance that the pressure was the same on the bottom of all only over an area equal to the area of the top of the vessel having the smallest top, which, we believe, is correct.]

The Four Tanks—The Two Boilers.

EDITOR SCIENTIFIC MACHINIST:

I claim you are in error in your answer to question 409, "W. M. B.," (issue of August 1st, '92), when you state "that the pressure is not equal in all parts of the bottom, nor is there the same total pressure in all of them." The pressure (per square inch of area on the bottom) is equal in all parts of the bottom, and the total pressure the same on the bottom of each tank.

The pressure of water on a square inch, is equal to the height in feet, multiplied by .434 pounds regardless of the form or diameter of the column of water above. In the tanks in question (24" diameter by 10 feet high) you will get 4.34 pounds pressure per square inch, or a total on each bottom of 1963.37 pounds. [If there was a perpendicular column of water 10 feet high over each square inch of the bottom of 24" diameter, in all the tanks, Mr. Boetcher's proposition would be correct, but there is not, so he is in error.—ED.]

In regard to question No. 378, "A. D. J.," (in issue of June 15th), will say that, in my judgment, A. M. Glidden has given the only true remedy for the trouble with "A. D. J.'s" two boilers, and will add, that if both feed-water and steam connections are of ample size, and he keeps the water in the boilers clean, I guarantee he will have no further trouble with them.

Raising the engine up about five feet, as suggested by A. D. J., will not keep the water from going to the engine, with the boiler setting he has in use. The engine being above or below the boiler, has nothing to do with water going to engine. If water once gets into boiler end of steam pipe, the current of steam will carry it to the engine, no matter what the position of the engine is, unless the steam pipe is unreasonably large, or is trapped. CHAS. BOETCHER.

"A. D. J.'s" Boilers Again.

EDITOR SCIENTIFIC MACHINIST:

I read with much interest Frank Wilcox's letter about "A. D. J.'s" two boilers. He seems to think something is "all wrong," and so do I. First, referring to "A. D. J.'s" manner of remedy, viz.: "make small boiler steam as fast as large one," it appears to me that, if these boilers are working at fair capacity, and small one is "pushed" to steam as fast as large one it would be sufficient cause for trouble with a properly set battery and much worse in this case, but "how are we to know when small boiler is doing this?"

But as to the trouble, which seems very clear to me, if small boiler is 18" lower than large one, it is a wonder to me that we have not heard from "A. D. J." some time before this; in fact, it is a surprise to me that "A. D. J." got any satisfaction out of his engine at all, for the following reason: Supposing small boiler to contain 32" or to be ⅔ full of water (which is generally sufficient, not knowing height of flues), this would allow only 32"—18=14" of water for large boiler, which is a great deficiency. On the other hand, if large boiler has sufficient supply the small one will have too much. As a remedy I think "F. W." is getting close, and I would put the tubes of both boilers on a level with each other, so I do not think it necessary to alter the engine-bed. I think we ought to hear from "A. D. J." again. If I have erred in the above, will gladly accept correction. V. M.

"A. D. J." to Frank Wilcox.

EDITOR SCIENTIFIC MACHINIST:

I notice some comment has been made on a question written to the MACHINIST by me. Frank Wilcox calls it water running down hill, but I do not. In the first place, the boilers are not connected in the manner he says. Neither did I claim they were, nor did I say I enlarged the steam pipe. I said the boilers were connected at bottom with two separate blow-offs, and that each boiler feeds independently of the other, and they are connected at the top with a 3" pipe, running from one to the other, and a tee in center between the two to connect to the engine. The top of both domes are on a level, and they both feed into blow-off. Now, let Mr. Wilcox tell how to stop the water from going from big to little boiler. I have stopped it without tearing down and building up again, and fixed it in half a day and no water now goes to the little boiler, unless fed there by injector. Let us hear from Wilcox again. Then, I will tell our brother how I fixed up.

Now, I would like to have Mr. Wilcox tell me how to set my valves to get the best results from the engine. The engine is 12"x24" steam chest, set on top of cylinder, eccentric connects with valve stem with rock shaft, with two rocker arms, one on outside of engine for rod connections, the other on center of shaft for valve stem, with 2 valves, either one of which is large enough for any common slide valve engine. When I took charge of the same, two years ago, there was a 2½" exhaust pipe and I enlarged to 4". The engine runs 165 revolutions a minute, with 85 lbs. boiler pressure to the square inch. There was so great a pressure on the valves that the rod could scarcely drive them. Now, at what point of stroke should it cut off, and how much lead do I want to give, and at what point of stroke? Please answer me this question through the SCIENTIFIC MACHINIST. A. D. JOELS, Ishpeming.

[Mr. Joels question, No. 378, says, "the little boiler is 18" lower than the large one." Was it an error of the editor?—ED.]

The Umbria's Fast Voyage.

The steamship Umbria of the Cunard line was signaled off Sandy Hook at 7:28 on Aug. 6, thus completing her trans-Atlantic voyage in 5 days, 22 hours and 5 minutes. The Umbria passed Daunt's rock at 1:30 on July 21. The best previous run made by a Cunarder, the Etruria, was in September, 1889, when the trip was made in 6 day, 1 hour, and 50 minutes. The best previous trip of the Umbria was in January, this year, when she crossed the deep in 6 days 2 hours and 5 minutes.

A Sun-Wound Clock.

A Brussels clockmaker has invented a clock which is wound up by the sun, and requires no other attention than being placed near a window into which the sun shines. A shaft exposed to the solar rays causes an updraught of air, which sets the fan in motion. The fan actuates mechanism which raises the weight of the clock until it reaches the top, and then puts a brake on the fan till the weight has gone down a little, when the fan is again liberated and proceeds to act as before.

THE Wheeling Iron & Steel Co., a big combine composed of the Belmont, Benwood and Top Hill companies of Wheeling, has organized by the election of Russell Hubbard president, J. D. DuBoise secretary. The combined concern will have a capital of over $3,000,000, and will be the largest iron and steel concern, after the Carnegie's, in the Ohio valley. The combine will begin the operation of all three of the plants at once.

BOILER explosions have not been as numerous lately as they were earlier in the year. But who knows but before this gets on the press the most destructive and lamentable one of the year may take place.

THE World's Fair should close on Sunday. There are no reasons deserving of serious consideration why it should remain open on that day.

So great has been the development of the petroleum fields in Peru that pipe-lines have been run from the main wells to the coast. The opinion is expressed that the Peruvian field will soon be able to supply the demand of all the west coast of South America.

THE patent on the Thompson indicator expires Aug. 31st next, having been granted in 1873.

Choice of Two Trains,
To Niagara Falls via Nickel Plate, on Tuesday, August 16th. Low rates and long limit. See Nickel Plate Agents.

Niagara Falls, Toronto and Thousand Islands,
Via Nickel Plate, Tuesday, August 16th. Choice of two trains. See bills.

Reduced Rates.
To the West via the Nickel Plate.

STEAM PUMPS.—IV.

BY J. C. SMITH, M. E.

As the duplex pump is the one which is in most popular use, it deserves more attention than any other class of pumping machinery, and it will be the aim of the author to dwell upon it more thoroughly than was done upon the classes previously described.

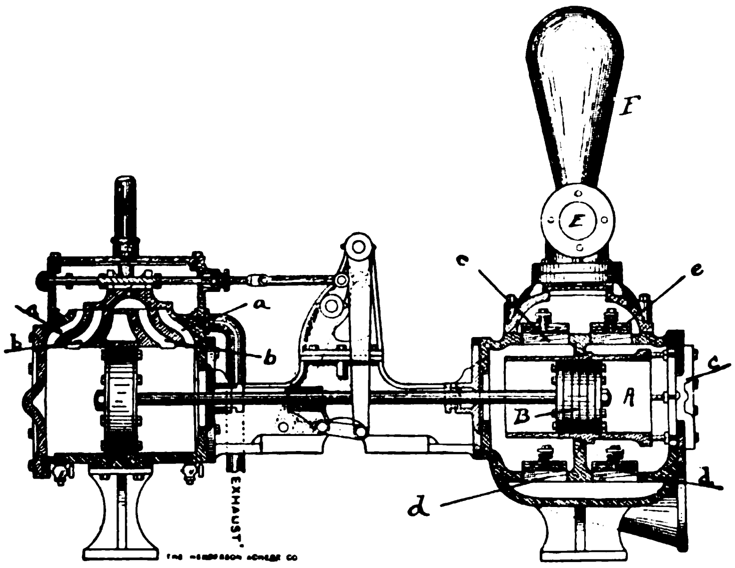
The accompanying cut is a longitudinal section of an entire duplex pump, showing the steam cylinder, packing boxes and water cylinder in section. The explanation of the double ported steam cylinder was given in our last article, in which it was explained how the presence of the exhaust steam acted as a cushion between the exhaust port *b* and the live steam port *a*.

Very often the compression betweem the ports *a* and *b* is too great, and, owing to this excessive compression, the pump falls shorts in making its stroke.

To overcome this defect, controlling valves are put in the cylinder with stems projecting out just below the steam chest, thus enabling the engineer to operate the valves by means of a wrench, or by means of hand wheels which are often put on the stems.

These valves are set in a passage communicating with the ports *a* and *b*, and so set as to close or open this passage at will, by the operation of these controlling valves.

By a little study, the use of these controlling valves will be readily understood. When the pump is working short in its stroke, opening these controlling valves allows the steam under compression between the ports *a* and *b* to escape through the connecting passage into the exhaust port *b*. This reduces the pressure of the compressed steam, and enables the live steam on the opposite side of the piston to move the piston farther along toward the end of its stroke. Very often in starting the pump without a load, the controlling valves being open, the pistons move so far along in their stroke as to strike the heads of the cylinders.



By closing the controlling valves, the resistance due to compression is increased, and the pistons are thus prevented from striking the cylinder heads.

A great variation in the length of the stroke may be obtained by the use of these controlling valves, the writer having seen as much difference as 4" in a pump of 12" stroke.

To those who are unaccustomed to caring for duplex pumps, these controlling valves are a source of study, and it is hoped that this explanation will serve to make their use more readily understood. The cut shows the section of the water cylinder, with water piston B attached to the other extremity of the piston rod, and working in the liner A, while the section and discharge valves are below and above the water piston respectively.

By the reciprocating motion of the water piston B in the liner A, the liquid to be moved is drawn into the pump through the suction pipe connected to the pump at D, and drawn through the suction valves *d* and forced by the return motion of the water piston B, through the discharge valves *e*, out of the pump into the discharge pipe connected at E. The air chamber F is set so as to be in direct connection with the discharge pipe; its object being to give an even pressure to the water discharged by the pump.

By studying the action of the duplex pump, it will be seen that one side starts before the other has come to rest; therefore, a greater volume of water is forced through the discharge pipe at E. This increased volume flowing through the discharge pipe must necessarily increase the pressure in the pipe; and, on account of the incompressibility of the liquid, this increase of pressure would be accompanied by a blow in the pipe, which is well known as the water hammer.

To overcome this disagreeable noise, and to keep a more even pressure in the discharge pipe E, the air chamber F is put in communication with the discharge main. It contains a column of air from the surface of the water to the top of the chamber; and, when this sudden increase of volume and pressure takes place, the confined air is compressed into a smaller space, while the pressure of the air increases. When one side of the pump has come to rest, the volume of the water discharged is decreased, and the compressed air forces the water accumulated in the air chamber into the discharge main, thus equalizing the flow of the water through the discharge main, and, therefore, maintaining a more uniform pressure in the discharge main.

As the confined air in the chamber F acts as a cushion for the pulsations of the water being discharged from the pump, the water hammer or thump on the pipe is thus overcome.

In high and long lifts, an air chamber called a "vacuum chamber" is also put in communication with the suction pipe, for the purpose of keeping the flow of the water to the pumps more regular.

The water piston B, in this case, is made with a follower head, which can be removed at will by taking off the head *c*, and taking out the follower bolts; in fact, this is the way in which the piston is packed. The follower head is taken off, and the packing, which for cold water and other liquids that do not act upon it, is ordinary square rubber packing is pulled out, and new packing, cut to the proper length, put in, the follower head being then replaced. Often the piston is so designed as to be adjustable, and for pumps which have to lift the water to any extreme height, it is commendable, as the packing, when it becomes worn, can be set out against the wall of the liner thus insuring a good lift in the suction.

Pumps of any considerable size should be made with the liner A, in which the piston B moves, removable, as it is a source of much inconvenience, when the liner has become worn, to disconnect the water cylinder and send it to the works to be re-bored; while, with a removable liner, a duplicate can be readily obtained; the only stoppage of the pump being through the time taken to change the liner.

The pump as shown is designed to pump a liquid free from grit or any thing that would tend to work in between the piston and liner and cut it. In pumping a liquid, carrying grit or dirt in suspension, a plunger pump should be used. In this case the plunger is much longer than the liner in which it works, and the liquid is forced through the pump into the main by reason of the displacement caused by the advancing plunger, for, as the plunger advances into that chamber of the cylinder which is filled with water, so much of the water is forced out as is taken up by the body of the plunger.

Plunger pumps are divided into inside and outside packed plunger pumps. In the former, the plunger is enclosed in the body of the water cylinder entirely, and works in a liner fastened in the center wall of the cylinder.

Outside packed plunger pumps are so designed as to have a plunger working in each end of the water cylinder through suitable packing boxes, and connected together by yokes and stretcher rods, so that they move together to make the pump double acting.

Inside packed plunger pumps are used in such service as requires but little pressure; but for service in deep mines, pipe lines, etc., where extraordinary pressure is required, the outside packed plunger pump is used. By the use of the latter the body of the water cylinder is much reduced in size, being brought down to a diameter but very little greater than that of the plunger.

The advantage of this is obvious; for, with a water cylinder of large dimensions, required to work against a heavy pressure, a large amount of area is exposed to the heavy pressure; this would require an extremely heavy water cylinder to withstand the enormous pressure upon its walls; but, when the cylinder is reduced in size and made to assume a circular form as much as possible, a reasonable thickness is then sufficient to stand the strain upon it.

The valves of the water cylinder are by no means unimportant, and should be given a great deal of attention. In the cut they are shown as *d d* being the suction valves, and *e e* the discharge valves. By a study of the figure, their action will be comprehended. As the piston B moves from one end of the stroke to the other, the suction valve *d* is lifted by means of a vacuum above it, formed by the action of the receding piston B, and the water flows in filling that chamber of the cylinder; as the other chamber is filled with water, the advancing piston exerts a pressure, closing the other suction valve *d* and lifting the discharge valve *e*, and forces the water through the upper chamber into the discharge main at E.

When the end of the stroke is reached, the discharge valve *e* is closed by the pressure above it, the direction of motion of the piston reversed, and the same operation repeated. Valves for ordinary use and pressure are usually made of a rubber disc, working on a stem which is screwed into brass seat with sector-shaped orifices, and which is secured in the body of the pump.

The valves are usually held to their seats by means of a conical spring or weight upon them. For pumping hot water or any liquid which acts upon rubber, or for pumping against heavy pressures, brass valves are generally used, and are ground to their seats to insure a tight joint.

By studying the action of the valves, it will be seen that, at the completion of each stroke, there is a rise and fall of the valve from which no useful effect is obtained in the discharge and filling of the pump barrel; this is called the "slip" of the valves, and, in pumps with much valve area, amounts to a great deal.

In computing the capacity of pumps of large dimensions, it is always taken into consideration, and usually rated at about 2 per cent.

A serious fault often arises in valve seats, and especially in those used for hot liquids on account of the difference in the ratio of expansion between brass (the seat) and cast iron (the body of the pump); they gradually work loose, and become a source of annoyance; to overcome this, the seats should be screwed into the body of the cylinder, or riveted over underneath to prevent their coming out.

Rare Opportunities.

The Queen & Crescent Route will place Excursion Tickets on sale to Texas and Arkansas, also Indian Territory, at greatly reduced rates, on August 30, September 27th, and October 25th. Good for return 20 days from date of sale. For rates, maps and further information, call on Agents of the Q. & C. Route, or agent at your station, or address D. G. Edwards, G. P. A., Cincinnati, O.

Reduction in Chautauqua Lake Rates.

The Nickel Plate will offer special rates to Chautauqua Lake. Do not let the season pass without visiting this queen of resorts.

LECTURES BY THE OLD MAN.

Mr. Technic, our ten cubs have decided to learn all they can of the elementary principles that combine in the make-up of a draftsman, and I have arranged with the firm to purchase ten sets of suitable instruments and the necessary paraphernalia requisite for their instruction. We will hold meetings one night of each week in this drawing room, and I will come round also whatever night is decided upon. Our plan is to devote the first six or eight evenings to gaining a comprehensive knowledge, use and care of the instruments. Then, putting a blackboard about four by six feet on that wall, we will have them study Inventional Geometry (the book only costing 35 cents, each one will have one), and have them work out and demonstrate on the board how to bisect, erect and project lines and formations, thus leading them gradually into the use of sines, cosines, tangents, chords, etc., without scaring them to death or having them holding you and I in holy reverence every time they come in contact with us.

In fact, interest them enough in trigonometry and geometry so they will desire future knowledge without having it clubbed into them. Simple, rude sketches of things about the shop will be their lessons to make drawings from, which will be made at their homes and submitted to us class nights for criticism and corrected instruction.

I also thought you and your two assistants might take a hand in the "noble and glorious work," and alternately devote an evening each week in their assistance as instructors. How does the idea strike you? You "never heard of it being tried that way? It is out of the usual course?" Of course it is. Hang a rut; I hate them. But it will prove interesting and I think they will learn twice as fast, besides it is throwing them on their own resources and brain fertility. When my physician makes my medicine interestingly sweet and palatable, I am interested accordingly, but if it is the same old dose, I carelessly toss it out doors and try to forget that I owe him anything.

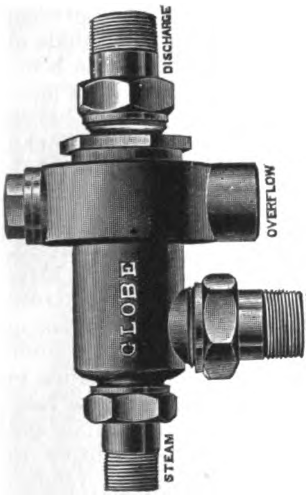
When the Irishman, working bare-headed in the broiling hot sun, was told that he would roast his brains, he replied, "If I possessed any brains I would not be working here." See? Create brains in the cubs.

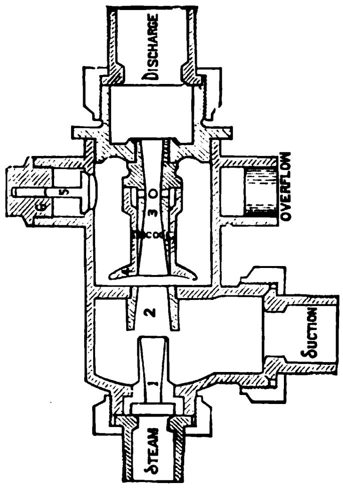
"What is to be gained by it?" Why, if nothing else we have made more intelligent workmen, with clearer conceptions of what is to be done to the piece of material placed in their hands. We save the time of the foreman now given to explanations of the drawings. We save the time now used by the workman to ponder over and study drawings, for with keener perceptions and quickened brain power he will comprehend what is required of him and do it. Having a personal knowlege of the headache, worry and trouble required to design and execute the plans from which he develops the machine, he will cease to sneer at "those dudes with the soft snap in the drawing room," and be more in sympathy with them. The draftsman knowing that the man at the bench or machine possesses also his knowledge, will be more in harmony toward him, and the present barriers between the shop and the drawing room will be leveled. There will be less liability for errors creeping into the work, and the firm's dividends will be greater without wholesale chopping down of wages. We will make better workmen, make a better firm, and have the satisfaction of knowing that we have done a little toward making the world better.

To carry out the plan means that some social evening recreations may occasionally have to be canceled but, in the end, I think the results will fully recompense any little inconveniences we may suffer. Well, just think the matter over and let me know what you think of it, and if I may count on your assistance. Good morning. The Old Man.

THE GLOBE AUTOMATIC INJECTOR.

This injector, illustrated here, is a simple, reliable and economical boiler feeder, equally adapted to all classes of boilers, and working satisfactorily under all conditions of high or low pressure, lifting water, or taking its supply from tank or city pressure. They have no handles to work, or moving parts about them; being started and regulated simply by common globe valves on the steam and water pipes.





They are very strong and hard to "break," while working, and where the water from any cause is temporarily interrupted, the injector, by its automatic action, instantly restarts as soon as the supply has been restored, without the help of the engineer.

The globe injector has the peculiar merit, it is claimed, of not being affected by overheating, it being impossible for the suction pipe to get heated. It has a remarkable range between its maximum and minimum delivery of water, which is governed entirely by "throttling" its water supply.

Any one can take it apart in a few moments with a common wrench and clean and replace parts without trouble.

For full particulars, address, The J. H. McLain Co., 10 S. Water street, Cleveland, O.

Rubber Tires for Carriages.

The success of rubber tires on bicycles has frequently led to attempts to increase the comfort of buggy and carriage riding by fixing tires on to the wheels, but in the majority of instances the attempt was not a success, as the tire either came off or wore out in a very short space of time. Since, however, pneumatic tires have displaced the solid ones on bicycles, the attempt is being renewed, and buggies and other vehicles are likely to be seen on the boulevards in large numbers before long as noiseless and free from vibration as bicycles. Carriage builders believe there is an immense amount of money to be made out of vehicles with rubber tires on the wheels, and they are likely to keep on experimenting until they finally succeed in producing the desired article.—[Globe Democrat.

Wrought Iron versus Steel Tubes for Boilers.

Mr. A. Blechynden of Barrow-in-Furness, England, has published an account of some very interesting experiments which he undertook with a view to ascertaining the relative excellence of wrought iron and steel in the manufacture of non-leaking boiler tubes. He used tubes of Siemens-Martin steel and Scotch BB brand of wrought iron in his experiments. The general result was that after successive heatings in a furnace and cooling on water the iron tubes were found to have contracted less than the steel tubes and that the steel tubes were much looser in their sockets than the iron tubes. His argument is, therefore, that wrought iron is more suitable for boiler tubes than steel, especially in high pressure boilers.—[Marine Review.

A New York firm have rented a phonograph, the object of which is to give playwrights who insist upon reading their plays a chance to do so. The dramatists are sent up to the top floor, the doors are locked and they are allowed to talk into the funnel as long as the funnel will stand it. Then, at their leisure, the firm send out for perfectos and let the phonograph tell its story.

The Simens & Halske Co., of Frankfort-on-the-Main, Germany, manufacturers of electrical apparatus, will establish a large branch in Chicago, for the manufacture of their specialties. The Lodge & Davis Machine Tool Co., Chicago, have sold the American branch a large assortment of engine lathes, radial drills, etc.

Grand Excursion to Chicago via Nickel Plate.

The German Warriors will run their fifth annual excursion to Chicago, August 20th. Special train leaves Cleveland 9 P M., Pearl street 9:10, Burton street 9:15, Lorain street 9:20, Detroit street 9:30 P. M. Tickets good seven days. For sleeping car berths apply to Browne & Thompson, Agents, 224 Bank street or Depots. Tickets for sale by Peter Lindenau. Pelton & Starkweather; H. Tielke, 873 Lorain; C. Schmidt, 624 Lorain; J. Krach, 992 Sheriff; the Savarian, Champlain and Ontario; W. Peters, 1031 Woodland; C. Asbeck, 627 St. Clair; M. Holhlfeldt, 570 Ontario, and committeemen at depots.

Chautauqua Lake

Is acknowledged by all to be one of the most delightful places where the warm summer months can be spent, and the Nickel Plate is affording its patrons every opportunity which can be desired for visiting this charming resort. They have instructed their Agents to sell excursion tickets at special reduced rates.

Cool Shade,

Can be found at Vermillion, O., and those who wish to attend the Camp Meeting at that place during July and August can procure excursion tickets via the Nickel Plate from June 21st to August 23rd at special rates.

German Warriors.

Special train with sleepers to Chicago via Nickel Plate, Saturday, Aug. 20th. $6 round trip. Tickets good seven days. Train leaves 9 P. M.

I. O. O. F. and Nickel Plate.

Tenth Annual Niagara Falls Excursion Combined runs August 16th. Enquire of Nickel Plate Agents.

Great Reduction In Rates.

To Denver, Col., Helena, Mont., Ogden and Salt Lake City, Utah. Ask Nickel Plate Agents.

A Visit To The West.

Could not be made at a better time than now. Ask Nickel Plate Agents for rates.

I. O. O. F. and Nickel Plate Combined Excursion August 16th. Tenth Annual Niagara Falls Outing. Chautauqua Free. Toronto, $1 extra. Liberal limits. Stop-over to visit friends granted on return trip at any point on the Nickel Plate.

Chautauqua Excursion Free; Toronto Excursion $1 extra. These side trips are arranged for the Nickel Plate Tenth Annual and I. O. O. F. Niagara Falls Excursion of August 16th. Enquire of Nickel Plate Agents.

I. O. O. F. and 10th Annual Niagara Falls Excursion via Nickel Plate, August 16th. Enquire of Nickel Plate Agents.

Go with the German Warriors to Chicago, Saturday, Aug. 20th. $6 round trip. Train leaves Cleveland 9 P. M.

Chicago excursion. German Warriors. Aug. 20th. Train leaves Nickel Plate depot 9 P. M.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(413.) J. E. D., Bethlehem, Ia., writes: "Where can I get fire-brick or fire-clay suitable to line the combustion chamber of a traction engine boiler?" *A.*—Write to the manufacturers of the boiler. If you do not know where they are, write to the Aultman & Taylor Machinery Co., Mansfield, O.

(414.) Garfield Injector Co., Wadsworth, O., write: 1. "Is it practical to heat with the exhaust steam of a 10 H. P. engine carrying 80 pounds pressure on the boiler, a room 40′x28′x9′? 2. How many cubic feet of air will one square foot of steam pipe surface heat? 3. Will it be necessary to have a pressure valve at farther end of heaters to hold the exhaust steam back? 4. Will the back pressure be sufficiently more to compel us to fire heavier? 5. In case exhaust steam would not be sufficient for coldest days, could live steam be turned on in some pipes with exhaust steam?" *A.*—1. This is hard to determine without more definite information as to evaporation performed by the boiler. We should think that it could be done if there is not more than from two to three pounds back pressure, but you will probably have no heat to spare at best. 2. One square foot of pipe surface will heat about 300 cubic feet of air from zero to 100° or 100 cubic feet from zero to 150°. 3. No. Put a back pressure valve on the exhaust pipe, set at whatever back pressure you want on the engine. This will relieve the pipes when the exhaust steam is too great in quantity for them to carry off without an excess of back pressure. 4. That depends on the number of feet of pipe and the number of curves in it that give resistance. If the pipes are put in properly it should not compel you to fire heavier than for the purpose of producing the power required. 5. If you wish to provide for the use of live steam when the exhaust steam may not be sufficient to heat your building, we would recommend you to arrange to use no exhaust steam when it will not do the work, and during this time to heat entirely with live steam. If you put live steam into the heating pipes with exhaust steam you will waste a great deal of steam, for your pipes for exhaust steam heating let the steam out when it has passed through them, while live steam is not used in this way. It is the object to use as little live steam as possible, or only sufficient to do the work. But the exhaust steam is dead—you are through with it and must get rid of it all, so you simply convey it through the pipes and exhaust it from the end of the pipe system instead of exhausting it from the engine cylinder into the atmosphere. If you turned live steam into the exhaust steam heating pipe it would do no more than to pass once through the pipes and then be exhausted, losing a large percentage of its energy. In order to use the same pipes for both, put a valve on the end of the heating pipe where the steam is exhausted, and when you find that the exhaust steam will not heat the building and want to use live steam, just close this valve, leaving it open only enough to let off the drip water, and turn the live steam into the heating pipe, exhausting from engine through the back pressure valve, which should then be thrown open. When you think the exhaust steam will heat your building, shut off the live steam from the heating pipe, open the valve in the end of the heating pipe, and set your back pressure valve again at the number of pounds back pressure you want.

(415.) W. T., Weston, Wis., writes: 1. "Where can I get a hydraulic ram pump? 2. When a boiler is idle, is coal oil injurious applied to the outside to keep it from rusting?" *A.*—1. Write to the pump manufacturers and supply houses advertised in our columns. 2. Coal oil will oxidize and rust. Use linseed oil.

(416.) A. D. J., Dexter Mine, Mich., writes: "Please let me know through "Questions and Answers" how to attach a lubricator to steam pipe above throttle valve on compressor. It is attached now with steam pipe ¼″ and 24″ long, and delivery pipe ¾″x6″ long. Now, it will not form a drop and raise, but blows the oil right through. I do not know the name of the lubricator." *A.*—Possibly the valve in the supply pipe is opened too wide when the lubricator is started. The steam does not condense, probably from one of three causes: on account of there being too much of it supplied; because there is not in the supply pipe surface sufficient for condensation, or owing to the extreme heat of the engine room. Try less steam, and if it does not work apply to the pipe waste soaked in cold water. If nothing else will stop it, put a coil supply pipe in to give more surface for condensation. It is attached all right, but don't forget to close it when you shut down, for if you do your oil will be blown into the boiler.

(417.) L. Reichhold, Oakland, Cal., writes: "Please settle a dispute, A friend of mine argues that architectural drawing is called a profession and mechanical drawing a trade. I say whatever the one is the other is also. What are they called?" *A.*—If one is not a profession the other is not. We think that the architectural drawing is more mechanical than mechanical drawing, the latter requiring more originality.

(418.) J. M. Fares, Pomeroy, O., asks: "Can you inform me where there is a good drawing school for machinists and engineers?" *A.*—On the 15th page of the SCIENTIFIC MACHINIST will be found the advertisement of a school of mechanical drawing.

(419.) H. P. B., U. S. S. Independence, Mare Island, Cal., writes: "Will you please inform me in your next issue of the SCIENTIFIC MACHINIST, or by letter, how to find the circumference of any circle? I know that it is a fraction over three times the diameter. I have cut out circles from one inch in diameter to six inches in diameter and found out that the circumference does not increase in proportion as the diameter increases in proportion—that is, by my measurements." *A.*—Multiply the diameter by 3.1416. Some use the fraction $\frac{22}{7}$, which comes near to it. Either your circles were defective or your measurements inaccurate, for the diameter and circumference must increase and diminish in exact proportion.

BOILER SCALE PREVENTIVES.

Let us consider the prevention and reduction of scale by the generally adopted plan of passing some chemical, either directly into the boiler, at the commencement of the week, or continuously along with the feed. The latter plan is to be preferred, wherever possible, particularly if the chemical and feed pass through the heater, the softening of the water when taking place, to a certain extent, outside the boiler, large quantities of the precipitated salts remaining in the heater. The practice of adding to the boiler, at the commencement of the week, what is judged to be sufficient composition for several days, is not to be recommended, causing, in the case of caustic compositions, the boiler to "kick," and also the fittings to be attacked and corroded by the alkali. This custom might be paralleled in ordinary life by a man taking his breakfast, dinner, tea, and supper at a sitting. Such a practice would certainly save time and trouble. There are innumerable substances in the market as boiler compositions, the following being by no means a complete list of the substances which form the basis of these concoctions, or have been recommended for use: Caustic soda, soda ash, phosphate of soda, silicate of soda, tannate of soda, fluoride of sodium, chloride of ammonia, sulphite of soda, potatoes, starch, dextrine, molasses, sugar, tannic acid, barks, shumac, gelatin, etc. The above substances roughly fall into three divisions, according to the manner in which they act, as regards the prevention of scale: (1) Those substances which aim at precipitating the incrusting salts from the water in such a form that they may be blown out of the boiler by a judicious use of the blow-off cock. To this class belongs the inorganic compounds such as the salts of sodium. (2) Those substances which have a mechanical action, rather than a chemical one, preventing the precipitated incrusting salts from uniting into a hard mass. To this class potatoes, dextrine, starch, etc., may be assigned. (3) Those substances which, when added to the water, increase the insolubility of the incrusting salts, and thus either entirely or partially prevent their deposition. To this class may be assigned gelatin, and also sugar, which, with lime salts, forms soluble saccharate of lime. Of course these divisions are not hard and fast ones, for substances classed as merely mechanical no doubt react chemically as well, whilst the sugars and gelatin act mechanically in preventing the hardening of any deposit that may form. In practice it is usual to mix the precipitating salts with some form of organic matter, no doubt in some cases with the twofold object of disguising the weakness of the solution, and also preventing the adhesion and cohesion of the precipitated salts, and where the organic matter is harmless such an addition for the latter purpose is decidedly to be recommended.

Caustic soda or carbonate of soda along with some form of organic matter enters very largely into the majority of compositions on the market. The use of these substances with carbonate waters is not to be recommended, as the alkali, after doing its work, still remains in the water, and if allowed to become concentrated, causes priming, and also attacks the fittings, setting up a series of reactions to which allusion has already been made. Where sulphate of lime is also present in the water, in quantities in excess of the carbonate, then soda ash is no doubt a most useful composition, as the carbonate of soda remaining in solution throws down insoluble carbonate of soda going into solution. It is generally advisable to have organic matter present in the composition to mechanically prevent the precipitated carbonate from cohering and adhering. With acid waters, carbonate of soda gives excellent results when added in suitable proportions. Silicate of soda or soluble glass, is not infrequently used as an anti-incrustator, its action being the precipitation of the lime and magnesia as silicates. Paul states that in certain cases the precipate sets hard, but the use of organic matter along with it, would, I believe, effectually prevent this. Of course excess must be carefully guarded against. Tannate of soda is very highly recommended as a boiler composition, its action being the precipitation of the lime as tannate of lime. This separates as a loose deposit, which does not adhere to the plates, and can therefore be blown out. Tannic acid, uncombined with soda, has been used, but it is found to have an action on the plates, and, therefore, is not to be recommended. The cost of tannate of soda constitutes the difficulty of bringing it into general use, and many of the so-called tannate of soda compositions are merely exhausted tan—that is, tan from which the tannin has been extracted, boiled with soda. Such substances as catechu, nut galls, oak bark, shumac, logwood, contain tannic acid, and owe their value as anti-incrustators to this substance, which acts chemically, and also in a less degree to other extractive organic matter, which acts mechanically. Sodium fluoride is given by Professor Lewes as being highly efficient for the prevention of incrustation. Amongst its advantages may be mentioned a very low combining weight, and the rapidity and completeness with which the lime and magnesia salts are precipitated, the precipitate showing no tendency to harden. Like several other very useful anti-incrustators, its cost renders the extensive application of it too great a luxury. There appear, however, to be prospects of this being sufficiently reduced to bring it into practical use. Potatoes, starch, dextrine, are frequently used in boilers, with or without soda. They form a slimy deposit on the precipitated salts, thus preventing their setting into a hard scale. It has already been noted that sugary matter owes its efficiency as an anti-incrustator to the formation of soluble saccharate of lime with the incrusting salts, thus preventing their deposition. Gelatin also acts by retaining the sulphate of lime contained in the water in solution, that substance being more soluble in a water containing gelatin. It is said by Mr. Paul to give good results with a carbonate water, containing at the same time a small amount of the sulphate of lime. On heating the water, carbonate of lime is precipitated along with some gelatinous matter, the sulphate of lime being retained in solution, and thus the hardening of the carbonate precipitate is prevented. In many quarters compositions generally are in bad odor, and are regarded as doing no good, or positively more harm than good. That such is very often the case is beyond doubt, because one composition is recommended for every class of water, and we have seen how unsuitable some chemicals are for particular waters—*e. g.*, caustic soda for carbonate waters. Another fruitful source of failure is the inadequacy of the quantity of chemical used to deal with the amount of mineral matter existing in the water. The fact is, the price charged for most compositions renders their application in anything like practical quantities far too expensive a process, and a thorough revision of charges is needed. One hundred and six grains of carbonate of soda will precipitate the lime of 136 grains of sulphate of lime as carbonate of lime, and the quantity of solution used should be calculated on reactions of this kind, together with a knowledge of the feed-water required per hour by the boiler, and not on the horse-power of the boiler. Directions as to the quantity of composition to be used, based on the horse-power, are very often issued with the concoctions, and are practically valueless, as the mineral matter to be precipitated varies widely with different waters, and of this such directions take no account.—[Industries.

THE job of inspecting boilers should suit Seventh Day Adventists better than men of any other persuasion, for about half the boilers are now inspected on Sunday, the day on which the Adventist begins his week's work.

Through by Daylight.
To Niagara Falls on Nickel Plate Excursion of August 16th. Low rates, long limit and stop-over on return trip at any point on Nickel Plate.

THE
TOOL
CATALOGUE
OF
1892.

EVERY reader of the Scientific Machinist should have a copy of our new TOOL Catalogue. A most complete book of 704 pages, bound handsomely in cloth and printed on good paper. Book will be sent express paid on receipt of $1.00 to any part of the world. Money paid for book will be refunded with the first order amounting to $10.00 or over. As a book of reference, information, etc., every person having occasion to use Tools should own a copy, even if they do not purchase their supplies from us.

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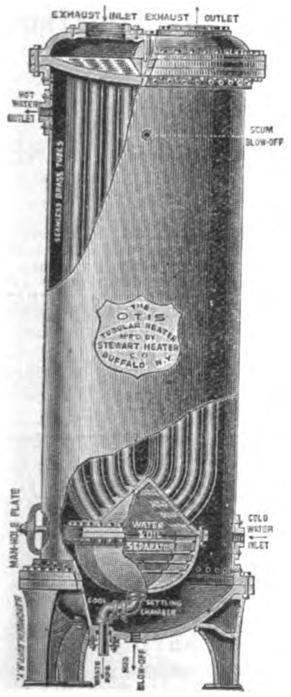

THE OTIS
Tubular Feed Water Heater & Purifier,
With Seamless Brass Tubes.

Guaranteed to heat the feed water to the boiling point (210° or 212°) with the exhaust steam, without causing any back pressure.

Also TO EXTRACT THE OIL from the exhaust which makes it practicable to use the exhaust steam, after passing it through the heater, for heating buildings, etc., and return the condensation from the heating system to the boilers free from OIL.

Being so constructed that the sediment settles below and away from the tubes in a cool settling chamber, it never gets foul with scale.

The tubes being bent, and lower tube sheet free to rise and fall, overcomes all possibility of leaks from contraction and expansion.

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STEWART HEATER CO.,
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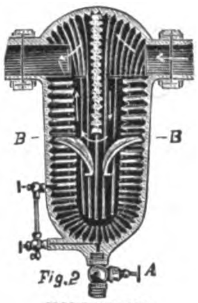

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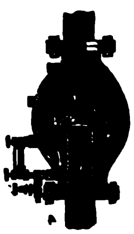

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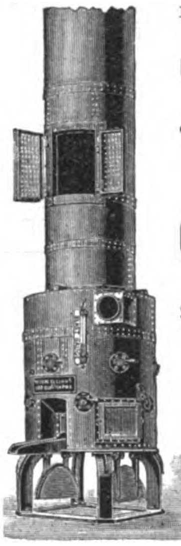

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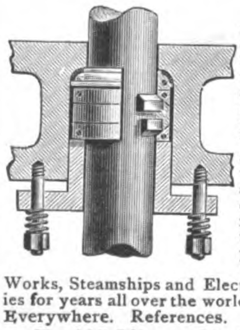

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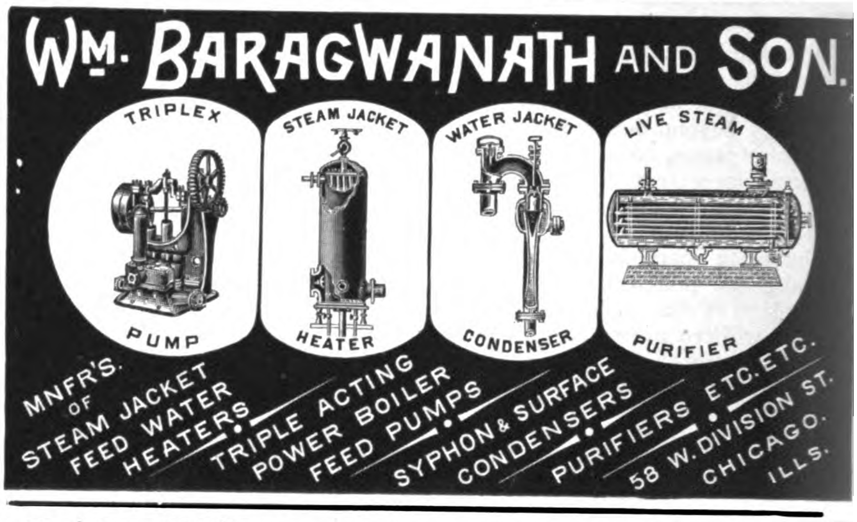
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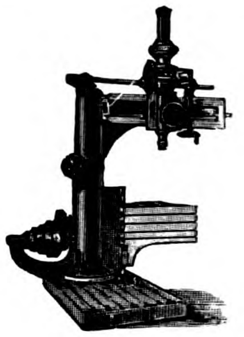

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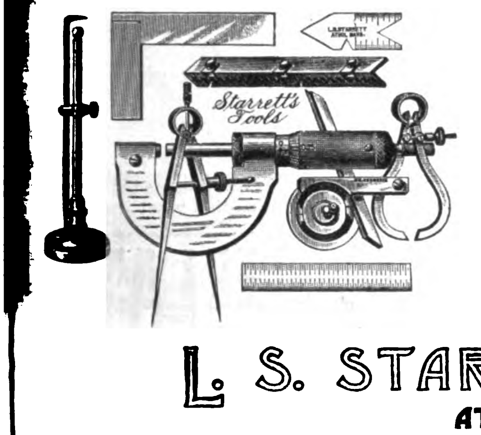

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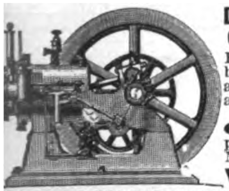

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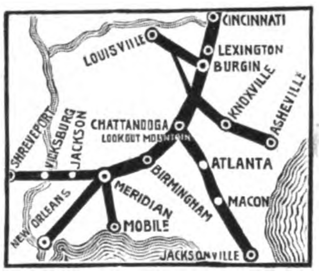

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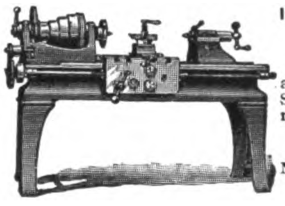

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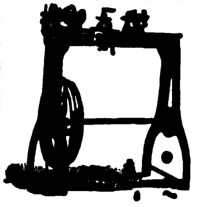

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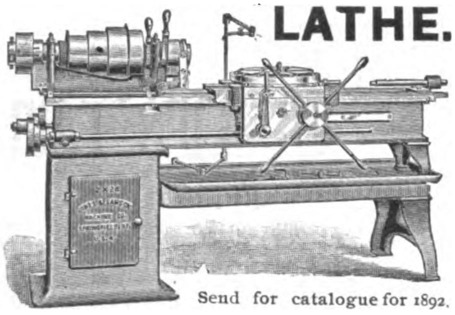

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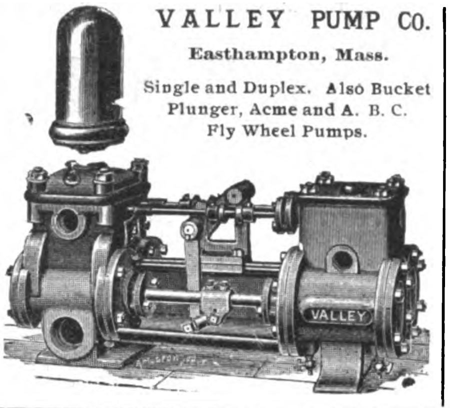

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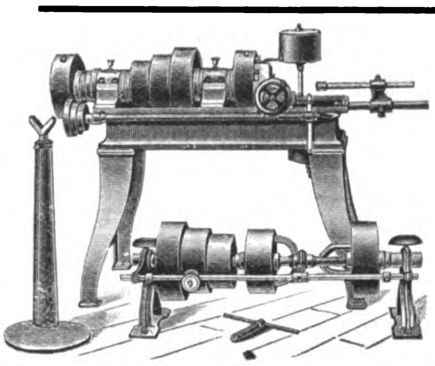

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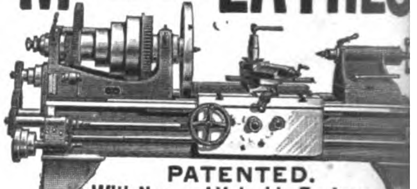

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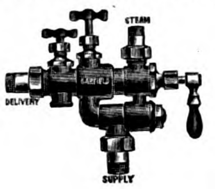

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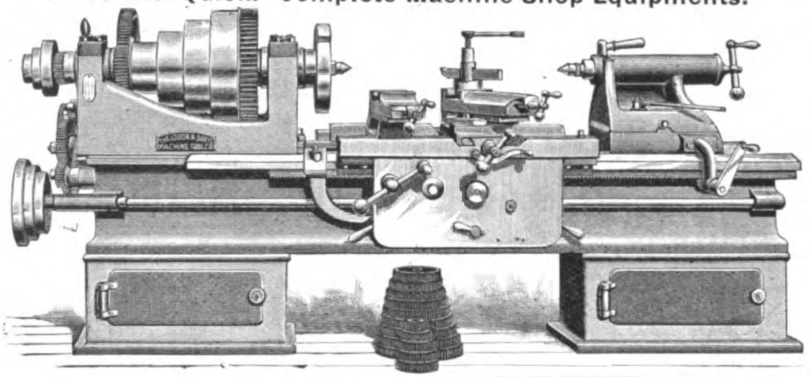

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IDEAL, No. 65.
Price, by mail, postpaid.

3 inch	$1.00	5 inch	$1.25
4 "	1.25	6 "	1.50

By using different size nuts we can place them on all sizes of our Ideal Calipers and Dividers.

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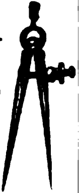

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3 inch	$1.15	5 inch	$1.50
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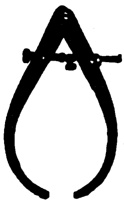

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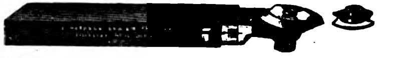

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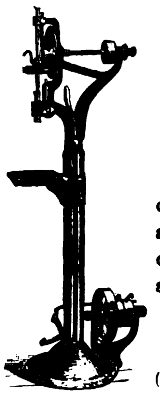

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Has these Great Advantages The speed can be instantly changed from 0 to 1600 without stopping or shifting belts. Power applied can be graduated to drive with equal safety the smallest or largest drills within its range—a wonderful economy in time and great saving in drill breakage. **Send for catalogue.**

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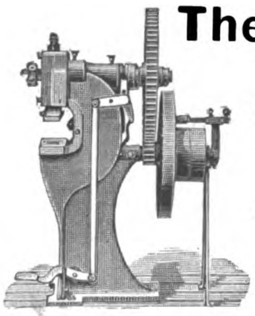

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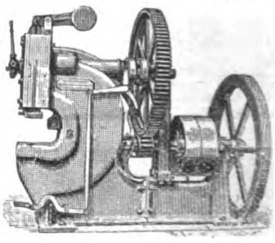

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To place our new Canton Sight Feed Lubricator on the market, we will furnish them at the following prices: ⅓ pint, $4.75; ½ pint, $5.50; 1 pint, $6.50; 1 quart, $7.50. **Special prices to Dealers.**

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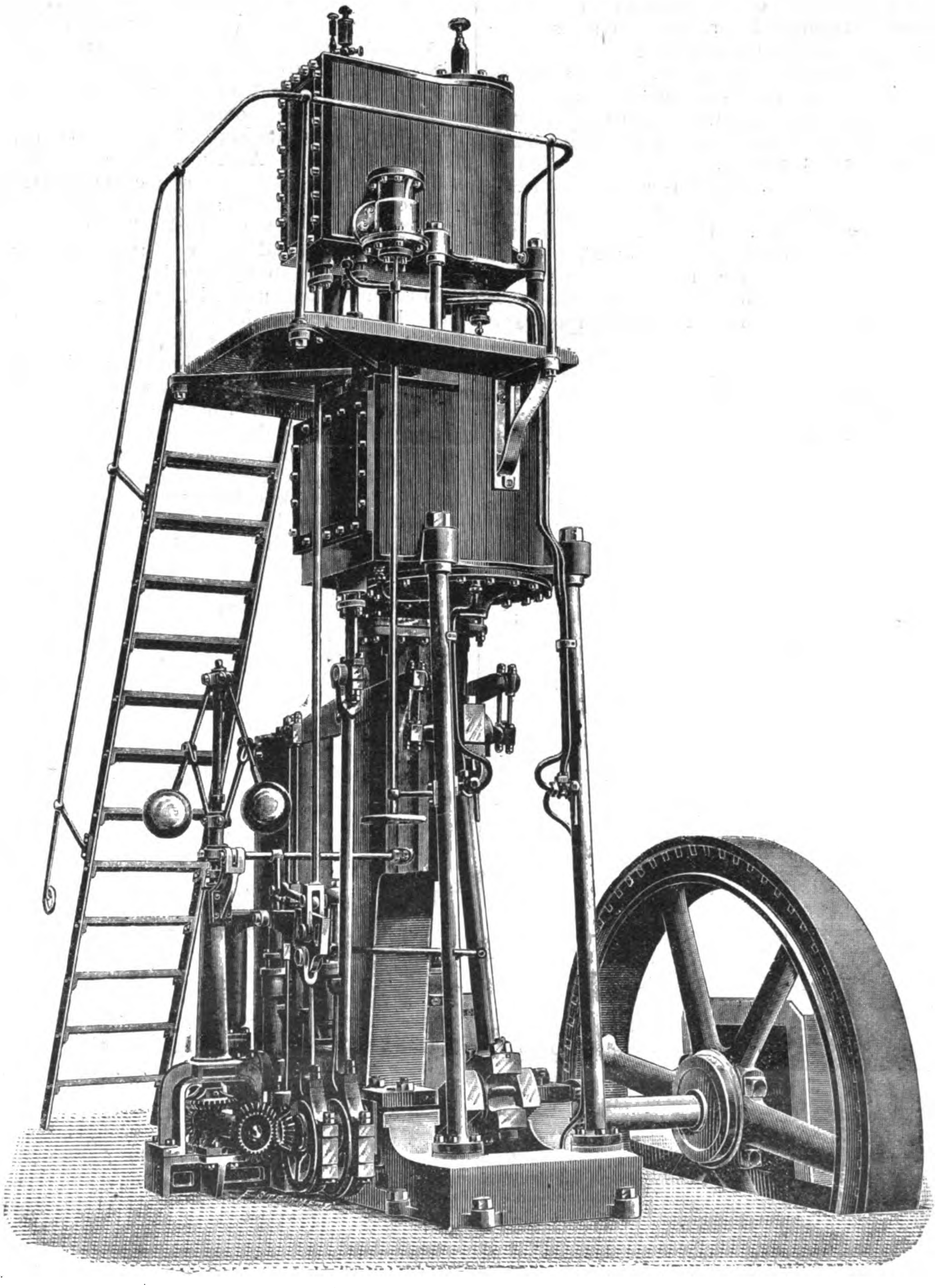
SCIENTIFIC MACHINIST

:VOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES

STABLISHED, 1882. CLEVELAND, O., SEPTEMBER 1, 1892. { VOL. X—NO. 17. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. TERMS:—$1.50 A YEAR, SINGLE COPIES, 7 CENTS.

TANDEM COMPOUND ENGINE.

The illustration herewith shows a style of tandem compound engine the inverted cylinder marine type, for use in one of the largest cement rks in England. The high-pressure cylinder is above the low-pressure linder, the diameters being 12 inches and 27 inches, respectively, with stroke of 25 inches. The valve gear is of the usual eccentric type, but e admission of steam to the high-pressure cylinder is automatically gulated by a separate expansion valve driven by an eccentric from the ain shaft and under the ntrol of the governor. normal speed of 80 revotions is thus maintained ıder varying loads on the ıgine. At this speed the ›wer developed is 150 ıdicated horse-power. he engine is fitted with jet condenser. A glance the illustration will show at the engine occupies :ry little floor space, and at the working parts reiiring attention have :en reduced to the miniium, so that it is well ited for driving machiny in factories and mills. s it had to be conveyed 'er a rough country with › railroads, special atntion had to be given in e design and construcın, to make each part of e engine as light as pos›le consistent with rength.



TANDEM COMPOUND ENGINE.

XPERIMENT WITH A STEAM BOILER.

In calculating the 'aporative capacity of ›ilers, says the Journal the Institute of Civil ngineers (Foreign Abracts), it is usual to ckon it at so many ›unds per square foot of :ating surface. But the ıthor is of opinion that is method is not suffi:ently accurate to deterine the maximum evapation at any given point, ıce evaporation is not ıd cannot be uniform roughout a boiler. A ›iler becomes overheated its hottest part—that is, e part subjected to the eatest heat, and the rgest quantity of water ll be here evaporated. › study the phenomena overheating, the effects heat at this particular ırt, and the amount of evaporation from it, must be determined. The ıthor isolated a portion of a boiler plate immediately above the bridge, here the heat is known to be the greatest and overheating most frequently kes place. He placed upon it a small vertical iron tube, which was firmly ›lted at the bottom of the boiler; the top of the tube rose above the vel of the water, and opened into the steam. The tube was fed through separate pipe with water at the same temperature as that in the rest f the boiler, and the quantity of water evaporated by this limited area of eating surface was carefully measured.

The experiment was made on a cylindrical boiler, with four separate lateral feed-water heaters. The boiler was 10 feet long, and 2 feet 2″ in diameter, with a heating surface of 35¼ square feet; heating surface of the feed-heaters, 107½ square feet; total 142¾ square feet. The grate surface was 3.85 square feet, and a blower increased the draught when a stronger fire was required. The small experimental tube was 4″ in diameter, with a heating surface of 19.3 square inches, bolted to the boiler, and the joint made with asbestos and india-rubber. The tube was connected to the water gauge of the boiler, and the same level of water maintained in both. Previous to an experiment the boiler was heated for several hours, and communication was then cut off between it and the experimental tube. During the trials the pressure in the boiler was kept at about 60 pounds. The fire was stoked as usual, the consumption of coal noted, and the total evaporative power of the boiler determined.

With different intensities of fire, the consumption of coal per hour per square foot of grate varied from 16 pounds to 48 pounds. The author, however, does not advocate such excessive duty, and considers that any consumption of coal above 30 pounds per square foot of grate represents a rate of firing inconsistent with the safety of the boiler. As a rule, with stationary boilers having the above proportions of heating to grate surface from 1.6 pounds to 2.4 pounds of water are evaporated per hour per square foot of total heating surface. Here the maximum evaporation was 94 pounds, and the minimum 19 pounds, or from two to four times as much as in a locomotive boiler. Evaporation was extremely active from the portion of the boiler surface covered by the tube, varying from 20 pounds to 49 pounds of water per hour per square foot of heating surface with moderate firing, and from 40 pounds to 48 pounds with strong firing. The forced draught increased combustion but not evaporation. The author concludes that, with stationary boilers working under ordinary conditions, evaporation at the part most exposed overheating ought not to exceed 20 pounds to 28 pounds of water per square foot of heating surface per hour, and never attains 50 pounds in practice.

CANADA has 75,768 industrial establishments—an increase of fifty-one per cent. in ten years. The capital invested is $353,000,000, an increase of 114 per cent.; 367,865 employes, increase forty-four per cent.; wages $99,000,000, increase $40,000,000; products, $475,000,000, increase $165,000,000.

PHOTOGRAPHY IN MECHANICS.

An important factor in the sale of mechanical manufactures, according to modern commercial methods, is the picture illustrating the article to which it is desired to call attention. Newspaper articles and advertisements, catalogues, circulars, letter and bill heads, and envelopes, and most other available mediums, are used for the purpose of illustrating the various articles manufactured. So universal has this custom become that its cost is considered quite as necessary and legitimate an expense as any of those classed as "incidentals." Electrotypes of the illustrations are generally used for printing in connection with such matter as requires the use of type, as where any other method is employed the press work for the picture requires to be done separately from the reading matter. The electros are made from two classes of relief engravings—wood-cuts and photo-engravings. In making the former, the usual method is for the delineator to make the drawing freehand on the whitened surface of the boxwood block, and from this the engraver cuts the lines necessary to produce the effects of outline and perspective, high lights and shadows. Frequently the work of the delineator is dispensed with and a photo print of the subject made directly on the whitened and silver sensitized surface of the block. This, if the photo-negative be a good one, will give the best results, as it is more reliably accurate as to details. By either method, however, the quality of the woodcut will depend on the skill of the engraver in reproducing, entirely by lines, the solid tints of the drawing or photograph, In photo-engraving, while there are several processes employed, they are all alike as regards the generic principle involved, which is the sharply defined etching produced on a gelatine surface by the action of the actinic or chemical light rays, in decomposing the silver salts used for sensitizing. A high degree of skill is necessary for the production of good work by this process, as a large amount of manipulation is required before the electro is ready for the printer. Photogravures, photo-lithographs and similar work in which the original solid tints are reproduced in the print, while exceptionally fine, are unfortunately inapplicable to such commercial purposes as those under consideration. As photo-engravings, like woodcuts, are composed of lines in relief, they cannot be made directly from a negative taken from the object itself. It is necessary, therefore, that a line drawing be made, from which the photo-negative is taken. This is sometimes made by the delineator, freehand, without any other guide than the eye and such proportionate measurements as are possible. Usually, however, the method pursued is to make a negative several times larger than the size desired in the engraving, and from this a silver print on plain paper is taken. The drawing is then made directly on the face of the print—that is, their equivalent in lines is made of the various tints, giving form and tone to the picture. The ink used for the drawing must be absolutely black, while the execution will determine the quality of final result, so far as regards the correctness of the reproduction. From this drawing the silver print upon which it was made is entirely bleached out by chemical means, and the ink lines remain intact. A photo-negative of the size required for the engraving is then taken, and from it, by any one of the several processes, may be made the electrotype used for printing. The effect of reduction in size from that of the drawing is to render the picture soft and pleasing, without in the least decreasing its sharpness of detail. Of course where it is necessary to avoid reversing the picture, a positive photo plate must be made from the negative, otherwise the picture would have, lettering, for instance, reading from right to left.

An important point in the value of all illustrations is not so much the correctness with which the originals are portrayed as it is the self-evident fact that the picture is the actual reproduction of the object. Without this peculiarity it might be accepted as a representation embodying possibly quite as much of imagination as of reality. And this is true quite as much of the photo reproduction as of woodcut; the fact of their being line engravings deprives them of the appearance of having been photographically delineated. For this reason the use of photographic silver prints has become very general by manufacturers of many lines of goods. Machinery, tools, hardware, stoves, furniture, mantels, etc., are shown to great advantage in a well-executed photograph, and they have an additional advantage as advertisements in that they are generally received with greater respect, and are preserved when cuts would be relegated to the paper basket.

One great objection to their use, however, is their considerably greater expense than that of cuts. The latter, after cost of making the electrotype, amounts to comparatively little for press work and paper; and while the cost of a negative may be very considerably less than that of a woodcut or photo-engraving of the same subject, the expense of paper and printing from the former cannot be reduced below a much higher figure. As, however, the value of photos may fairly be inferred from their extensive use, the question of how most cheaply and conveniently they may be produced becomes of considerable importance. The usual method is to send for the photographer, who comes with his camera and takes the exposure. After waiting from a day to a week he sends a proof for approval, and if satisfactory, the order for prints is executed, light permiting, as early as the amount of other work on hand will permit. This generally means from one to two weeks from time of making the negative, and very frequently this delay amounts to a serious inconvenience.

That in all things possible a manufacturing establishment should be self-contained and depend on outside sources only for such work as cannot be profitably done within its precincts, will hardly be disputed. Every establishment in which the work is made from design drawings has its drafting department. The draftsmen and designers are usually men of intelligence and of attainments more or less scientific. Photography is a science no longer confined to professional practice, as through its wonderful development among amateurs some of the most important improvements have been made. Many of these amateur photographers are men whose occupations are in the line of designing and drafting in the several branches of manufacture alluded to. For such as are not already proficient, the acquisition of the necessary knowledge and skill to make them so would be more in the nature of recreation than a task, more pastime than study, a it is safe to say that were this additional duty to become a generally recognized feature of the drafting room, there would be few complaints from th draftsmen.

The cost of an outfit complete, for all the requirements, from taki the exposure to finishing the prints may be made comparatively small. O course the indulgence in unnecessarily expensive apparatus and accessori would be a temptation to the amateur, but need not be so to the busine man, who is purchasing for the use of others than himself, and would therefore take a cold-blooded matter-of-fact view of the requirements. For a work not of an exceptional character the expenditure of a sum not to exce $100 will provide not only necessaries but conveniences as well, and th amount of space required for an operating or dark room may be made a small as 6 or 8 by 10 feet. The latest improvements in facilities for ph tography permit of the production of almost all varieties of work with th same apparatus and materials, and this by a wonderfully small amount o labor and trouble as compared with the more antiquated methods an appliances. The use of emulsion or dry plates has been a most importan step in simplifying the production of the negative, not only as regards th matter of manipulation, but also the greater certainty of results unde varying conditions.

The standard makes—such as Carbutt's, Cramer's, Seed's, and severa others—are familiar to all users of the camera. The wonderful sensitiveness and almost absolute uniformity as to quality and rapidity seems almost inconceivable when we realize how brief is the interval of exposure necessary to produce the almost perfection of detail in an instantaneous picture. For instance, with a proper light, a picture may be taken of a rapidly moving object—a revolving wheel, for instance—and the action of the shutter be so quick that the wheel will have the appearance of being at rest, the spokes and all parts being as sharply defined as if there were no movement whatever. When it is considered how small an amount of motion with relation to the time of exposure it requires to give a blurred or indistinct outline, and compare this with the rapid motion of the circumference of the wheel, some idea may be had of the speed of the shutter and the consequently infinitesimal duration of exposure of the plate to the action of the light. And, notwithstanding their extreme sensitiveness, the same plates may be used for time exposures, whether long or short, and give equally good results; although all makes are finished of different sensitometer numbers, to suit all kinds of work.

The principal advantage of using the less rapid plates is that they are much less liable to fog or other injury from accidental exposure to light than the instantaneous grade, and are, therefore, somewhat more convenient. It may be said that as much is due to the quality of lens used as to that of the dry plate. Possibly so. The plate could not receive the image of the object unless it were thrown on it by the lens. This, however, does not in the least detract from the wonderful promptness with which the plate responds to the action of the lens. In regard to the latter, the degree of excellence does not depend entirely on the cost. While the expensive high grade lenses are, as a rule, reliable, as capable of giving perfect work, there are those of cheaper and simpler construction, at far less cost, which are capable of work which cannot be excelled by the best. Naturally, much depends on the care and skill of the operator in regard to arrangement of the object, light focusing, etc., as no amount of excellence in the facilities will produce good results if carelessly or ignorantly used.

The gist of all this is, the suggestion that it is practicable, as well as desirable, for all establishments whose line of business requires the use of photos for presenting their goods, to make instead of buying them. As a means to this end, it would be desirable that mechanical photography become a regular branch of study in technical schools, and that it be considered an essential element in the education of mechanical draftsmen and designers. Also that the dark room and a complete photographic outfit form an adjunct of every well regulated drawing room, and as necessary as the universal blue-printing apparatus. It is not many years since the latter was unknown—now it is considered indispensable. When it is considered how great the inconvenience—unavoidable, perhaps, but none the less real—of depending on outside parties for this work, then, if it be a fact that it is both practicable and economical to have it done in the drawing room, it would seem quite as inadvisable to forbear the advantage of such a possibility as to have the working drawings themselves made outside. That some of the more progressive manufacturers have adopted the plan—and, it may be safely asserted, will continue to follow it—may be considered a fairly good argument as to its desirability; and it is not improbable that the time may come when it will be considered as indispensable to such lines of business as have been mentioned. That there will be modifications and improvements in the kinds of photo prints used for commercial purposes is probable as a matter of development. For instance, the use of albumenized paper, with its unpleasant "shine"—making it necessary to hold the picture in a certain position with reference to the light—might be dispensed with to advantage. In its stead a plain surface paper may be used, upon which the picture will have all the softness and artistic character of an etching, and may be viewed in any convenient position, irrespective of the direction of the light. In sharpness of detail, the print is quite equal to that from the same negative made on albumenized paper.—[Iron Age.

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A tin roof well painted will not need repainting for 10 to 15 years. If you need any paint it will pay you to send for circular.
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JOSEPH DIXON CRUCIBLE CO.,
JERSEY CITY, N. J.

ANALYSIS AND TESTS OF DRAWING PAPER.

The multiplicity of materials used by paper manufacturers has rendered the testing and analysis of this product a difficult operation, and one which necessitates the use of really scientific methods.

The following is, according to the *Revue de chimie industrielle*, the method by which these tests are carried out at Charlottenburg. The operations relate to the following points:—

a. Tenacity and elasticity.
b. Resistance to rubbing.
c. Thickness.
d. Nature of the size employed.
e. Ashes.
f. Nature of the materials composing the stock.
g. Presence of chlorine or free acid.

The analysis includes mechanical processes, chemical essays and especially microscopic examinations.

To determine the tenacity, a certain number of strips, taken in different senses, are tried on a special machine, called the Gartyg-Reisch; the mean of the results is taken, and the tenacity is expressed in terms of the length of the strips essayed, whereat they break; this figure is easily deduced when the weight of the paper and the coefficient of tension are known.

The Gartyg-Reisch machine gives also the degree of elasticity of the paper.

For the resistance to rubbing, a sample is simply rubbed between the hands during a given time; the number of operations necessary to obtain complete disaggregation is proportional to the quality of the paper.

The thickness is determined very exactly by means of an instrument provided with a micrometer screw.

The nature of the size is determined by means of chemical reagents: a sample of the paper is boiled in water and a solution of tannin is poured into the decoction; if gelatine (animal glue) be present, a precipitate shows itself, or the liquid becomes at least turbid. To liberate vegetable glue, a decoction is made of the paper in alcohol; when this decoction is poured into cold water, the resin is precipitated.

The amount of the size in the paper is estimated by the following ingenious method; several lines are traced on one side of the paper with an aqueous solution of perchloride of iron, and the paper is then laid on a solution of tannin with the unwritten side downwards; the time which elapses between the placing of the paper in the bath and the blackening of the lines is proportional to the amount of size.

Commercial cellulose does not leave one per cent. of ashes; if the paper leaves a greater proportion, it proves that mineral substances have been employed, and the percentage of them is easily determined.

The presence of chlorine is easily detected by means of starch, saturated with iodide of potassium; this latter then takes a bluish hue.

The detection of free acids is a very delicate operation, and is preferably performed by the Gertzberg process, by means of a sensitive red.

In good papers, however, it is rare that traces of either chlorine or free acids are discovered.

The microscopical tests are often very useful; a small piece of the paper is placed on the stage of the instrument, and a drop of a solution of iodine poured upon it; if the paper is made from wood pulp, the fibres will turn yellow; if flax, hemp or cotton alone form the stock of the paper, the coloration of the fibres will be brownish yellow, and if the paper be made of pure cellulose, the iodine will in no way affect the color of the fibres.

It is better, for the microscopical examination, after having damped the paper with the iodine solution, to boil it in a porcelain capsule with a few drops of alcaline solution; if the paper is sized, the solution will become, after two or three minutes, of a yellowish tint. After a quarter of an hour's boiling, the paper pulp is washed in water, then held in fresh water to be examined with the microscope.

The appearance of the different vegetable fibres is not the same in the pulp of the paper that it is at the beginning of the process of manufacture; the determining of the materials composing the stock is therefore difficult and can only be done by an expert. The *Bulletin de la Societe d'encouragement pour l'industrie nationale* published some time ago a series of drawings which singularly facilitate the determination of the fibres.

It is well known that the average quality of the paper made in Germany has sensibly improved of late years, and there is no reason to doubt that this result is in a great measure due to the influence of these scientific analyses and tests.—[Revue Scientifique.

SPEED OF MACHINERY AT NIGHT.

It has been very often asserted, and perhaps as often denied, by millers and others in charge of running machinery, especially machinery driven by water power, that it runs stronger at night than in the day-time. The men who have noted these differences have been and are, for the most part, simple artisans, says the *Mechanical News*, skilled in their business but unlearned in the arts and sciences in general, and therefore, without being able to explain the phenomenon, still assert with great positiveness that machinery does run faster or stronger at night than in the day-time. Those who contradict the statement lay some claim to a knowledge of the natural laws and natural science in general but nothing about the practical part of operating machinery. The one class asserts, on the strength of positive knowledge acquired by continued experience and observation, while the other class contradicts on theory alone born of a supposed thorough knowledge of natural laws.

It is one of those peculiar cases where both are partly right and both partly wrong. There is perhaps no question but that machinery has been frequently detected running stronger at night than during the day, but not necessarily so, and those observing these facts are right in the statement of the facts but wrong in the conclusion that the phenomenon is due to the fact of its being night-time. The others are wrong in contradicting the known facts but right in the conclusion that night-time does not necessarily furnish additional strength or speed to running machinery. All motion is affected by the atmosphere and the denser it is the heavier and more sluggish the motion of machinery, or anything else that moves, and the more rarified and lighter it is the freer and apparently stronger motion is. Not only that, but the water that propels the machinery is affected by the same causes. The lighter the atmosphere is the heavier, relatively, the water is and the greater its power for performing work. Thus with less atmospheric resistance to motion and heavier water, the machinery necessarily runs faster or stronger with the same gate or quantity of water. Some have imagined that the heavier the atmosphere the more effective the water on account of the increased pressure on the surface of the water. That, however, is a manifest error, because the pressure of the atmosphere is equal in all directions and the pressure above the wheel is balanced by the pressure below it, while the increase of atmospheric pressure, which means an increase of buoyancy and density, reduces the actual weight of the water and therefore the power. This can be better understood if, in imagination, we increase the density or specific gravity of the atmosphere to a point greater than that of water. The latter would thus have no power, but would float aimlessly in the atmosphere as vaporized water, or clouds, now do, or as lighter fluids or solids of a less specific gravity float on water. As an equality of density between the atmosphere and water destroys the effectiveness of the latter, so does any increase of atmospheric pressure or density affect the power of the water in proportion.

When the barometer indicates the lowest pressure then will water-driven machinery run the strongest, whether it be at day-time or night, and that condition probably occurs more frequently after the mid-hour of night than at any other time. But whether or not at that hour all nature, animate and inanimate, barring wind and storms, is silent and still and the dreamy miller or other watcher having nothing on his hands or mind but to watch the mill, quickly notes any change that occurs in the running of the machinery—changes that would not be noticed in the busy hours of the day—are observed and hence the reason for the belief that machinery runs faster at night than in the day-time.

Laws Governing the Use of Traction Engines on the Highways.

In last week's issue we published a lengthy and very interesting article from the pen of Mr. John Maclaren, a well-known British manufacturer of engines, on "Traction Engines and Their Use," in which he presents the difficulties that makers and users of traction engines have encountered on account of the numerous legislative restrictions imposed upon the latter by act of parliament, instances of which we have given from time to time. He says: "Until 1878, the law with regard to these engines was in a a most unsatisfactory state, and users were practically at the mercy of any local crank who chose to lay a complaint against them. In that year, however, when the highway act was passing through the house of commons, opportunity was taken to consolidate and somewhat amend the law relating to the use of locomotive engines upon the highways." A tax or license fee is imposed on such engines when used for other than strictly agricultural purposes; and the bridge regulations are described as "most inequitable and vexatious." In fine, he shows that if the law and its construction by local authorities were more liberal, the use of traction engines in Great Britain would be greatly extended.

In the United States the demand for such engines is steadily increasing, and the laws governing their use on the highways in the different states are, occasionally, being applied. The June 21 number of *Farm Implement News* contained notice of a decision of the supreme court of Pennsylvania, declaring a traction engine used on the highway for general hauling purposes a nuisance, and information has been sent us that the authorities of certain counties in Iowa have notified owners of steam threshers that they will be held strictly to the observance of the state laws in relation to the occupancy of the highways and the crossing of bridges, and inquiries upon this subject have recently been coming in from various quarters. In view of the present and prospective use of traction engines, and the importance of having liberal, equitable and uniform laws, we have asked information of parties well posted relating to the laws now in force, and suggestions as to their amendment. We shall be glad to hear from anyone interested.—[Farm Implement News.

An Electrical Carriage on Chicago Streets.

Some months ago we gave a description of an electrically propelled carriage. "On Thursday of last week," says the *Western Electrician*, "a trip was made in Chicago from 538 West Monroe street to Jackson boulevard and thence to the corner of La Salle and Monroe streets. The trial was under the auspices of the Battery company and was an entire success. The route as taken is about three miles in length, and with several stoppages the distance was covered in 22 minutes. Five persons were in the wagon, and with the entire 24 cells in use, with which this wagon is equipped, the ammeter indicated the use of from 30 to 40 amperes. Later the same evening the wagon was run back to the starting point, at J. B. McDonald's residence, and from there to Garfield Park and return, making a trip of from eight to nine miles and then by no means discharging the cells. With the same batteries a day or two later the wagon was run from West Monroe street to Harold Sturges' residence north of Lincoln park, on the lake, and thence through the park, attracting much attention. The motor was built by William Morrison at Des Moines, and is said to be too light for the vehicle. The steering device is very ingenious, and is apparently just suited for the purpose. The Battery company will rebuild the motor and probably place the wagon on exhibition in some of the parks in Chicago or at the World's Fair."

ALL but one of the 42 cities in the United States, with population of from 50,000 to 200,000, have, we believe, electric railways in use.

SCIENTIFIC MACHINIST

Formerly, **WESTERN MACHINIST.**

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THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, SEPTEMBER 1, 1892,

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

HOW TO STRIKE.

The late railroad strikes following close upon the heels of extensive iron mill strikes, mark an epoch of independence and prosperity as well as of uneasiness among wage earners. Although we are not inclined to overlook the cool indifference of a Carnegie living at ease and spending his American-earned money in the country which reduced his father to a state of poverty, and in which he himself was unable to rise; still, there is much useless talk about Mr. Carnegie and other manufacturers making money too fast for the good of their employees, and too little movement on the part of employees to reach the state of prosperity which Mr. Carnegie and many others enjoy. It is said that the manufacturer is accumulating too rapidly. It is even said that he is taking bread from the mouths of his employees and their familes in order to satify his ambition for wealth and power; that the employee is going down while the manufacturer is going up; that the one is getting poorer and poorer as a whole, and the other is getting richer and richer. This is a one sided view which is entirely in contradiction to American biography, observation and experience; and a view which has been the cause of recent strikes, destruction of property and bloodshed.

There is just one way to prove these statements either false or true. And by all means let us prove them before we act on them. If the employees suspect their employer of making too much money over their heads and under their hands, let them co-operate and take the business out of his hands, furnish the capital, do the work, run the risk and have all the profits. It will always do the employees some good to have a little of the financial responsibility on their shoulders. As it is, most of them are running but little risk and they must therefore lose, or think they lose, a part of the profits that should be theirs.

President Ingalls, of the Big Four railway, is said to have recently advised the stockholders of one of the feeders of that road to turn a part of their stock over to the employees of the road as a preventive of strikes. It might be advisable for every railroad or other corporation to do the same thing for the same object. This, however, suggests a cure for all that sort of social evil known as discontent among the laboring classes. The trades unions claim to have a great deal of capital. They are called wealthy organizations, who have laid by enough money to bridge them over long strikes. Some of these workmen are individually men of wealth. Several of the Homestead strikers are said to have accumulated $25,000 to $50,000, or more. The aggregate strength of a union composed of such men, who are able to live for years without work, if necessary, to bring their employer to terms, would be sufficient to build and equip many factories, blast furnaces, steel and iron mills, railroads and industries of various kinds, besides accepting large construction contracts on their own responsibility, and conducting affairs generally independent of any one man. And why don't they do it? If they really think that Mr. Carnegie or any other manufacturer is making too much profit, why don't they take the money they have laid by in their Amalgamated Association treasury and put it into a competitive concern that will do all the business and make all the money?

When they begin to make some moves in this direction they will be credited with sincerity in their claims and their attitude toward the manufacturer. The facts are that many instances can be cited when the manufacturer has been doing business at an actual loss, merely to keep his men employed until he could reach a profitable contract. This, however, does not need to be brought into the question. It should be only a matter of confidence in the business. If the men think there is a great fortune in the manufacturing business of their employer, and that he is not dividing up liberally with them, it is only fair for them to start a concern of their own that will do the same work and make the same profits.

Everything is favorable to such a strike as *that* in this country, and everything is unfavorable to the ordinary blood and thunder incendiary strikes that are now in vogue among the trades unions of America. Anarchy has no sympathy among true Americans, who are well versed in the advantages of American institutions. And money and time expended in support of such a course is money and time thrown away.

WE TOLD YOU SO.

That open-faced fraud known as the Order of the Iron Hall has speedily fulfilled our predictions of March 15, 1891, and come to grief. On Aug. 23, Judge Dennis, of Baltimore, appointed Charles J. Wiener and Joseph C. France receivers for the order, and notice was served on all the depositors of funds in that city, deposits on hand amounting to $135,000. News of this collapse spread to other branches of the order and created a panic in other cities which results in the complete annihilation and disbanding of the entire order.

Next!

Yes, there are thousands of people awaiting the advent of the next. It may be a promise to give ten dollars for one, or even more, and still it will find plenty of believers who have vague ideas about the birth of fortunes, and who will swallow the bait and lose their money. Unfortunately, these extraordinary schemes attract the people who can least afford to be defrauded. The Iron Hall was directly an appeal to mechanics, who all earn their money by hard and patient toil. Indeed, it is a mark of shrewdness in the management to give an institution of that sort a name or feature that will be sure to capture the people who are most in need of big returns for their investments. If it starts out with a patronizing name and a lithographical letter head, there is but little danger of its failure to ruin or cripple the laboring classes by the thousands and perhaps hundreds of thousands.

We still plead for legislative protection from these unpent evils. Can we not see all savings and beneficiary institutions required to deposit a guarantee fund with the State, and then prove their plans before competent inspectors appointed by the State executives for that purpose. In this way the State would become a guarantee of their solidity, and there would be no lottery or chance, no misrepresentation or fraud.

LOSS FROM THE USE OF WORN-OUT MACHINERY.

It is poor economy to continue a tool or machine in use after it has served its time and is ready for the scrap pile. Yet we see it done every day. Machines that will turn out less than half the work that new ones would are being run in many shops and manufacturing establishments. The slow operation is not the only loss. Inferior work, stock spoiled and time spent in rigging and fixing up are to be added—and important additions they make. Often labor less skilled can do with a good machine what can be done only with much more costly help on an old tool.

Nor is the machine shop the only place where great loss is entailed by the use of worn-out machines. Steam plants are even more in need of attention. The possibilities of waste at the source of power are very great. Badly designed furnaces, boilers venerable with age and in execrable condition, defective chimneys, bad steam connections and appliances worn out, shaky engines and incompetent engineers and firemen, are costing manufacturers enough every year to cut down very materially the aggregate net earnings of all concerns using power. Manufacturers who will go out of their way to save a piece of material worth ten cents and scold their workmen for not looking carefully to economy in this direction will listen complacently to the complaints of their foremen condemning used-up tools, and the recommendations of their engineers that repairs, or new purchases of engines, boilers, pumps, injectors, packing, lubricators, etc., be made, and pass them by with the mental comment that "guess if they have served so long, they can a little longer," or something of that kind, seemingly blind to the fact that the worn-out machinery is eating up earnings enough to buy new in a short time.

If they looked more to the performance of machinery there would be less complaint of small margins.

THE extent of the street railroad interest in the United States may be estimated from a recent report, which states that there are 4,783 miles of such road in operation, having 32,505 cars and employing 60,764 men. The total number of passengers carried last year was 2,023,010,202, being 349,820 per mile of road work and 62,237 per car.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with question if he requests his name withheld. It will give the editor pleasure to assist, through his column, all readers, if possible, and he cordially solicits practical queries.]

(420.) "Mechanic," writes: 1. "Supposing twisting stress to be applied at one end of a solid shaft and resistance at the other, what is the heoretical shape of a shaft? If larger in center, like old style connecting rods, how are the proportions computed. 2. What simple book on strength of materials can you recommend to a plain mechanic? Haswell s unsatisfactory." *A.*—1. If you mean to ask what will be the appearance of the fracture, the answer is that all depends on the grain and the quality and kind of metal. Some shafts will fracture like a piece of green, spiral grained wood, others will tear asunder in the weakest point, the entire racture covering from four to ten inches of the shaft, while others will break off almost as blunt and as clean as a piece of chalk. So far as the strain necessary to fracture it is concerned, it would make no difference whether it was larger in the center or not. It would be no stronger than he weakest point. In regard to the question concerning the pipe, we do not quite understand it. 2. We know of no better work than Haswell on he strength, or stress of material. Trautwine is equally as good, but both are published for mechanical engineers. We have never seen or heard of a book attempting to give this information without employing formulas.

(421.) A subscriber, whose letter has inadvertently been lost, wishes to know how many cubic feet of gas are required to support 100 pounds. *A.*—A 1,000 cubic feet of ordinary coal gas has a buoyancy of about 42½ pounds, when confined in a holder like the receivers used by gas companies.

(422.) Joseph Downing, writes: "I have been running a George Corliss engine now for over two years and I can say with confidence, that I have not had any trouble with hot bearings, only the connecting rod knocking between the crank and cross-head. I was under the impression that the connecting rod wanted tightening up and of course I tightened it. But finding it did little or no good, and caused more friction on the crank pin, which I had to watch very closely, I tightened it up two or three times, which I found was no use. I at once came to the conclusion that there was something the matter with the piston head. I set to work to examine it and found the adjusting bolts were loose, I put in the head again and found that it had taken it up a little by setting out the piston head. That however, did not take it up as I thought it would. But, anyhow, I was determined to find it out, and so I got a little instrument called the steam indicator, and I applied it to my engine and found out the mischief. I have not been troubled since with my connecting rod. I send you a few cards. Please work out one or two of them for me. You will oblige me by sending me the way in which you work them out, in figures. The engine that I am running is 12"x36" and 30" stroke, and the speed 80 revolutions per minute." *A.*—The cards contain the area, so we must conclude that you are pretty well informed on the figuring of cards. To find the mean effective pressure, the area being known, divide the area in square inches by the length of the card in inches, to get the average height, and multiply the result by the number of the indicator spring used. The quotient will be the M. E. P. Having the mean effective pressure, proceed as instructed in the answer to question 372, in the May 15th issue.

(423.) C. F. W—r, writes: 1. "How should drawings be made to illustrate an article for publication? Does the writer pay for the cut or do you make them yourselves? 2. Please give me any information regarding articles for publication which might be of interest." *A.*—1. The best way to illustrate a simple device is to make an outline drawing, finished and so correct that no alterations are necessary. It should be made with black ink on drawing paper. From this a photo-engraving is made, which is a reproduction of the drawing. We will make cuts from drawings of devices or "wrinkles," which we consider worthy of space in the paper, if the drawings are furnished in good shape. The lines should be strong and plain. 2. What we desire most is practical information. Useful "kinks" and methods of doing work, "knacks" applicable in the engine and boiler room, and brief descriptions of handy devices and of the way the writer has got over difficulties, are always welcome.

(424.) W. D. T., West Morris, Conn., writes: "What is the best way to learn locomotive engineering, and if by firing, where should one apply for a job, and can a man without any railroad experience get a job as fireman?" *A.*—The best way, as you have suggested, is to get a job firing. Go to some engineer or master mechanic and have him procure you a job as fireman. No previous experience in railroading is necessary to procure such a situation, or fill it after it is procured.

(425.) J. H. W., St. Louis, Mo., asks: "Why does a stop cock swell and how can I prevent it." *A.*—It may expand a little. This you can not prevent, but don't drive it in so hard.

(426.) C. A. F., writes: "Will you kindly inform me through your valuable paper, what the standard sizes are for metric screws which has recently been adopted in Germany? If you cannot, will you tell me where I can find out?" *A.*—We are not informed, but we here request any of our readers who know, to give us the information. If none of them respond, we will employ other means to ascertain, if it is a fact that any different standard has been adopted.

(427.) Eugene Derrel, Auburn Junction, Ind., writes: "Will you please to let me know through your paper if mercury confined in a glass tube, would have the power to raise a damper according to the rise and fall of the temperature, the damper being very near on a balance, and just enough heft to push the plunger down as the mercury falls. Would the mercury work in a brass tube." *A.*—That depends upon all the conditions. We do not exactly understand you, but do not think that it could be prevented from escaping.

(428.) K. J. W., of Lexington, Ky., wishes to know the name of the best book on steam and electrical engineering. *A.*—If locomotive engineering, we would recommend Forney's "Catechism of the Locomotive," price $3.50; if marine engineering, Edwards' "American Marine Engineer," price $2.50; and stationary engineering, Edwards' "Practical Steam Engineer's Guide," price $2.50. On electrical engineering we would recommend, Slingo & Brooker's "Electrical Engineering," price $3.50. Any of the above can be furnished by Henry Carey Baird & Co., 810 Walnut street, Philadelphia, Pa., at above prices, post paid.

(429.) Wm. C. Anderson, Dayton, O., writes: "In the last issue of your valuable paper, in the lectures by 'The Old Man,' he recommends the use of the 'Inventional Geometry.' Please let me know through the 'Questions and Answers' where the book can be obtained, and at what price." *A.*—"Inventional Geometry, a series of Problems," by Wm. George Spencer, is published by the American Book Co., of New York, Cincinnati, and Chicago. Price 35 cents.

☞ Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

GROUND PLAN OF JACKSON PARK, CHICAGO.

Some months ago we published a cut of the World's Fair grounds. The one presented on page 9 is nearly a duplicate of it, but is larger and shows the most recent alterations. The scale in the corner will give a very clear idea of the dimensions of the grounds, buildings and waterways. We shall, from time to time, publish illustrations of interest to our readers pertaining to the great fair. We shall have numerous photographs taken as the work progresses, and will reproduce whatever we think will be interesting.

Wood Ties the Best.

The officers of the Pennsylvania Railroad Company have come to the conclusion, says an exchange, that the metal ties which they have been experimenting with for the past fifteen years are not a success, and have given orders that all that are now in use shall be taken up and the old style of wooden ones substituted. The company had metal ties placed at a number of places along the line, and experience has shown that it is almost impossible to keep them in place, especially on curves. They were rigid in their action, solid in their bearing, and generally got in a shaky and uneasy condition, as they took a poor hold on stone ballasts. Moreover, it is asserted that wooden ties have unchanged in price for many years past. So far, wood seems naturally applicable to railroad cross-ties. It forms a cushion, deadens the sound, is cheaper than any metal or composition which has yet been found. The Pennsylvania Railroad Company has not only tried the best makes of metal ties of this country, but imported a number from England, the best known standards in use. The standard metal tie of the London & Northwestern Railroad Company was tried, but the heavy traffic on the P. R. R. soon crushed it out of all shape.

Know Your Business.

Mr. Vanderbilt pays his cook $10,000 a year, my boy, which is a great deal more than we get—because he can cook, that is all. Presumably because he can cook better than any other man in America, that is all. If Monsieur Saucegravi could cook tolerably well, and shoot a little, and speak three languages tolerably well and keep books fairly, and sing some, and understand gardening pretty well, and could preach a fair sermon, and knew something about horses, and could telegraph a little, and could do light porter's work, and could read proof tolerably well, and could do plain house and sign painting, and could help on a threshing machine, and know enough law to practice in justice's court in Kickapoo township, and had once run for the legislature, and knew how to weigh hay, he wouldn't get $10,000 a year for it; he gets that just because he knows how to cook. It wouldn't make a cent's difference in his salary if he thought the world was flat, and that it went about its orbit on wheels. There's nothing like knowing your business through and through, my boy, from withers to hough, whether you know anything else or not. What's the good of knowing everything?—[Robert J. Burdette in the Pathfinder.

Silver Bronze Packing.

From the numerous flattering testimonials received by the Silver Bronze Packing Co., of 115 Liberty street, New York City, we learn that this excellent packing is proving a great success.

The Providence Match Co., of Providence, R. I., write: "It is giving better satisfaction than anything we have ever tried." Chesbrough Bros., Emerson, Mich., say, "Packing has proved all right, so far. Shall send you in a few days a list of rods which we wish packing for." Peperill Mfg. Co., of Biddeford, Me., write: "The packing is doing splendid work, and we shall undoubtedly want more of it." Sup't of Motive Power Central R. R. of N. J., writes that he ran a locomotive for over one year under the Silver Bronze Packing application, "and never had any trouble with it whatever."

These are only a few of the almost constantly occurring praises addressed to the Silver Bronze Packing Co., 115 Liberty st., New York City.

THE DEVELOPMENT OF THE STEAM-ENGINE.—VII.

BY PROF. R. H. THURSTON.

Development of the Marine Engine.

The early marine engine was an early outgrowth of the work on the steam-engine in the latter part of the eighteenth and early portion of the nineteenth century.

In 1690 Papin proposed to use his piston-engine to drive paddle-wheels to propel vessels; and in 1707 he applied the steam-engine which he had proposed as a pumping-engine to driving a model boat on the Fulda, at Cassel. His pumping-engine forced up water to turn a water-wheel, which, in turn, was made to drive the paddles. An account of his experiment is to be found in manuscript in the correspondence between Leibnitz and Papin, preserved in the Royal Library at Hanover.

December 21, 1736, Jonathan Hulls took out an English patent for the use of a steam-engine for ship-propulsion, proposing to employ his steamboat in towing. He proposed using the Newcomen engine, fitted with a counterpoise weight, and a system of ropes and grooved wheels, which, by a peculiar ratchet-like action, gave a continuous rotary motion. There is no positive evidence that Hulls ever put his scheme to the test of experiment, although tradition does say that he made a model, which he tried with such ill success as to prevent his further prosecution of the experiment.

In 1774, the Comte d'Auxiron, a French nobleman and a gentleman of some scientific attainments, constructed a steamboat, and tried it on the Seine, with the aid of M. Perier. This experiment proving unsuccessful, M. Perier built another boat, which he tried independently in 1775, but was again unsuccessful, owing principally to the small power of his engine. In 1778, and again 1781 or 1782, the French Marquis de Jouffroy, who, in his later experiments, used quite a large vessel, succeeded in obtaining such good results as to encourage him to persevere, but, political disturbances driving him from his country, his labors terminated abruptly.

About 1785, John Fitch and James Rumsey, two ingenious American mechanics, were engaged in experiments, having in view the application of steam to navigation. Rumsey's experiments began in 1774, and in 1786 he succeeded in driving a boat at the rate of four miles an hour against the current of the Potomac, at Shepardstown, Maryland. Rumsey employed his engine to drive a great pump, which forced a stream of water aft, thus propelling the boat forward. This same method has been tried by the British Admiralty in the *Water-witch*, a gunboat of moderate size, using a centrifugal pump to set in motion the propelling stream, and with some other modifications which are decided improvements upon Rumsey's rude arrangements, but which have not done much more than did his toward the introduction of "hydraulic propulsion," as it is now called. John Fitch was an ingenious Connecticut mechanic. After roaming about until forty years of age, he finally settled on the banks of the Delaware, where he built his first steamboat. In 1788 he obtained a patent for the application of steam to navigation. His boat was sixty feet long and twenty wide. The propelling apparatus was a system of paddles, which were suspended by the upper ends of their shafts, and moved by a series of cranks, one to each, taking hold at the middle, and giving them almost exactly the motion which is imparted to his paddle by the Indian in his canoe. Fitch's boat, when tried at Philadelphia, was found capable of making eight miles an hour. It was laid up in 1792.

In 1788 Patrick Miller, James Taylor, and William Symmington attached a steam-engine to a boat with paddle-wheels, which had been built by the first-named, and tried it for the first time on Dalswinton Lake, in Dumfriesshire, Scotland. This boat having attained a speed of five miles an hour, another was constructed and was tried in 1789. This vessel was driven by an engine of twelve horse-power, and made seven miles an hour. This result, encouraging as it was, led to no further immediate action, the funds of the experimenters having failed.

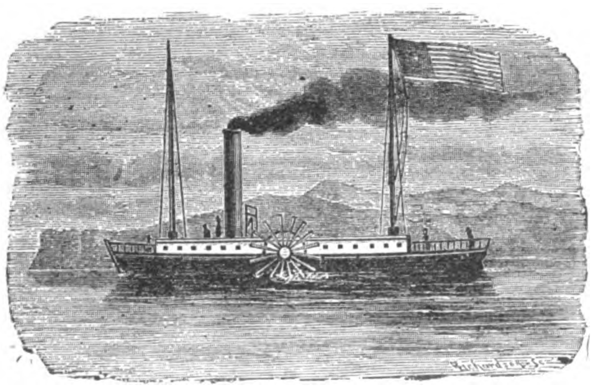

FIG. 17.—THE CLERMONT, 1807.

In 1801, however, Symmington was employed by Lord Dundas to construct a steamboat, with a design of substituting steam for horse-power on canals. The *Charlotte Dundas*, as this boat was named, was so evidently a success that the Duke of Bridgewater ordered *eight* similar vessels for his canal; but his death, soon afterward, prevented the order being filled.

At this time, several American mechanics were also still working at this attractive problem. In 1802–'3, Robert Fulton, with Mr. Joel Barlow, in whose family he resided, and Chancellor Livingston, who had also then taken up a temporary residence in Paris, commenced a small steamboat 86 feet long and of eight feet beam. The hull was altogether too slight to bear the weight of the machinery, and when almost completed, the little craft literally broke in two, and sank at her moorings.

The wreck was promptly recovered and rebuilt, and in August, 1803, the trial-trip was made in the presence of a large party of invited guests. The experiment was sufficiently successful to induce Fulton and Livingston to order an engine of Messrs. Boulton and Watt, directing it to be sent to America, where Livingston soon returned. In 1806, Fulton followed, reaching New York in December, and at once going to work on the vessel for which the English firm sent the engine, without being informed of its intended use. In the spring of 1807 the *Clermont* (Fig. 17), as the new boat was christened, was launched from the ship-yard of Charles Brown, on the East River, New York. In August the machinery was on board, and in successful operation. The hull of this boat was 133 feet long, 81 feet beam, and seven feet in depth. The boat soon afterwards made a trip to Albany, making the distance of 150 miles in 32 hours running time, and returniug in 30 hours. The sails were not used on either occasion. This was the first voyage of considerable length ever made by a steam-vessel, and the *Clermont* was soon after regularly employed as a passenger-boat between the two cities.

Fulton, though not to be classed with James Watt as an inventor, is entitled to the great honor of having been the first to make steam-navigation an every-day commercial success, and of having thus made the first application of the steam-engine to ship-propulsion which was not followed by the retirement of the experimenter from the field of his labors before success was permanently insured.

The engine of the *Clermont* (Fig. 18) was of rather peculiar form, the engine being coupled to the crank-shaft by a bell-crank, and the paddle-wheel shaft being separated from the crank-shaft, but connected with the latter by gearing. The cylinders were 24 inches in diameter and of four feet stroke. The paddle-wheels had buckets four feet long, with a dip of two feet.

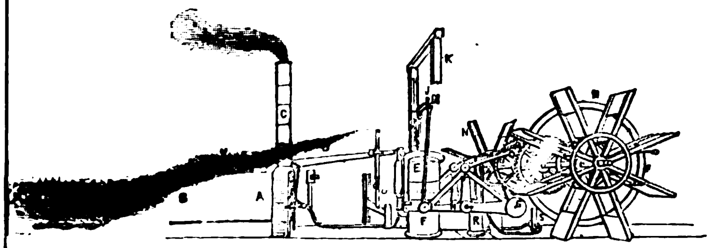

FIG. 18.—ENGINE OF THE CLERMONT, 1807.

Subsequently, Fulton built several steamers and ferry-boats, to ply about the waters of the States of New York and Connecticut. The *Clermont* was a boat of but 160 tons burden; the *Car of Neptune*, built in 1807, was 295 tons; the *Paragon*, in 1811, measured 331; the *Richmond*, 1813, 370 tons; and the *Fulton the First*, built in 1814–'15, measured 2475 tons. The latter vessel, whose size was simply enormous for that time, was what was then considered an exceedingly formidable steam-battery, and was built for the United States Navy. Before the completion of this vessel, Fulton died of disease resulting from exposure, February 24, 1815, and his death was mourned as a national calamity.

The prize gained by Fulton was, however, most closely contested by Colonel John Stevens, of Hoboken, who has been already mentioned in connection with the early history of railroads, and who had been, since 1791, engaged in similar experiments. In 1789 he had petitioned the Legislature of the State of New York for an act similar to that granted Livingston, and stated that his plans were complete and on paper.

In 1804, while Fulton was in Europe, Stevens had completed a steamboat 68 feet long and 14 feet beam, which combined novelties and merits of design in a manner that was the best possible evidence of remarkable inventive talent, as well as of the most perfect appreciation of the nature of the problem which he had proposed to himself to solve.

The steamboat boiler of 1804 (Fig. 19) was built to bear a working pressure of over 50 pounds to the square inch, at a time when the usual pressures were from four to seven pounds. It consists of two sets of tubes, closed at one end by solid plugs, and at their opposite extremities screwed into a stayed water and steam reservoir, which was strengthened by hoops. The whole of the lower portion was inclosed in a jacket of iron lined with non-conducting material. The fire was built at one end, in a furnace inclosed in this jacket. The furnace-gases passed among the tubes, down under the body of the boiler, up among the opposite set of tubes, and thence to the smoke-pipe.

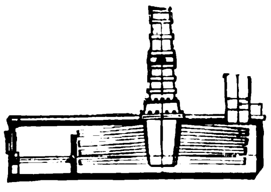

FIG. 19.—STEVENS'S "SECTIONAL" BOILER, 1804.

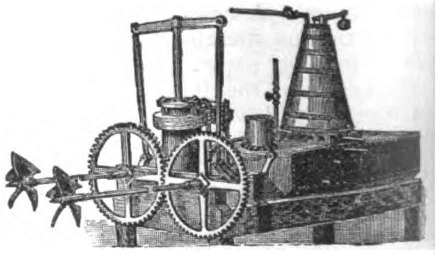

FIG. 20.—MACHINERY OF TWIN-SCREW STEAMER OF 1804.

The engine (Fig. 20) was a direct-acting, high-pressure condensing engine of 10" diameter of cylinder, two feet stroke of piston, and drove a *screw* of four blades, and of a form which, even to-day, appears quite good.

The first of Stevens's boats performed so well that he immediately built another one, using the same engine as before, but employing a larger boiler, and propelling the vessel by *twin-screws* (Fig. 21), the latter being another instance of his use of a device brought forward long afterward as new, and since frequently adopted. The boat was sufficiently successful to indicate the probability of making steam-navigation a commercial success, and Stevens, assisted by his sons, built a boat which he named the *Phœnix*, and made the first trial trip in 1807, just too late to anticipate Fulton. This boat was driven by paddle-wheels. The *Phœnix*, shut out of the waters of the State of New York by the monopoly held by Fulton and Livingston, was placed for a time on a route between Hoboken and ew Brunswick; and then, anticipating a better pecuniary return, it was oncluded to send her to Philadelphia to ply on the Delaware.

At that time no canal offered the opportunity to make an inland passge, and in June, 1808, Robert L. Stevens, a son of John, started with aptain Bunker to make the passage by sea. Although meeting a gale of ind, he arrived at Philadelphia safely, having been the first to trust himlf on the open sea in a vessel relying entirely upon steam-power. From is time forward the Messrs. Stevens, father and sons, continued to conruct steam-vessels.

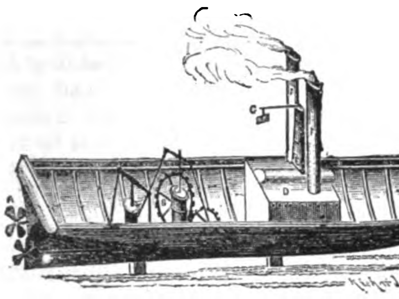

FIG. 21.—STEVENS'S TWIN-SCREWS, 1805.

The steam-engine in most general use for sea-going ships when the troduction of the screw compelled its withdrawal, with the paddle-wheel hich it drove, was that shown in Fig. 22, which represents the sidever engine of the steamer *Pacific*, as designed by Charles W. Copeland. 1 the sketch, A is the steam-cylinder; B C the side-rods, or links, conecting the cross-head in the piston-rod with the end-centre, D, of the de-lever D E F, which vibrates about the main centre E, like the overad beams. A cross-tail at G is connected with the side-lever and with e connecting-rod G H; which latter commnicates motion to the crank J, turning the main shaft J. The air-pump and condenser are seen t O M. This engine was one of the earliest and best examples of the pe, and perhaps the first ever fitted with a framing of wrought iron.

After the experiments of Stevens, we find no evidence of the use of e screw, although schemes were proposed and various forms were even atented, until about 1836.

In 1836, Francis P. Smith, an English farmer, who had become intersted in the subject, experimented with a screw made of wood, and fitted a boat built with funds furnished by a Mr. Wright, a London banker. le exhibited it on the Thames and on the Paddington Canal for several onths. In February, 1837, by an accident, a part of the screw-blade was roken off, and the improved performance of the boat called attention to e advisability of determining its best proportions. In 1837, Smith exhibed his courage and his faith in the reliability of his little steamer, by aking a coasting-voyage in quite heavy weather, and the performance of is vessel was such as to fully justify the confidence felt in it by its designer. he British Admiralty soon had its attention called to the performance of is vessel, and to the very excellent results attained by the *Archimedes*, a esssel of 237 tons burden, which was built by Smith and his coadjutors in 838, and tried in 1839, attaining a speed of eight knots an hour. By the erformance of the *Archimedes*, the advantages of screw-propulsion, espeally for naval purposes, were rendered so evident that the British Governent built its first screw-vessel, the *Rattler*, and Brunel adopted the screw the iron steamer *Great Britain*, which had been designed originally as a ddle-steamer.

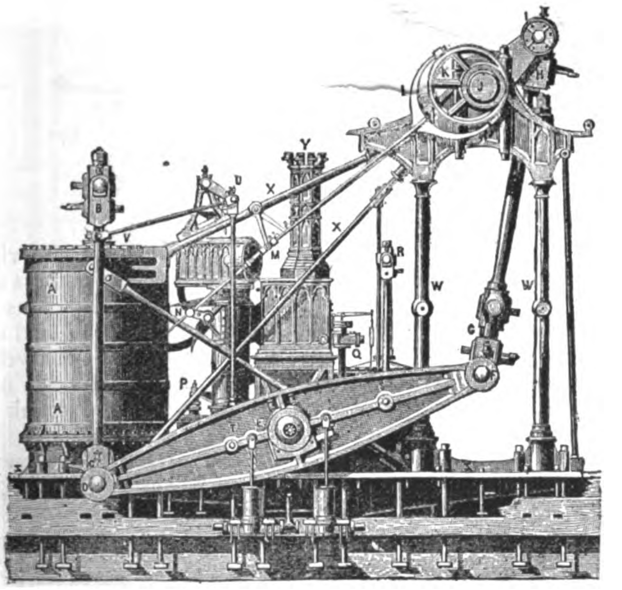

FIG. 22.—COPELAND'S SIDE-LEVER ENGINE, 1849.

Simultaneously with Smith, Captain John Ericsson was engaged in the me project. He patented, July, 1836, a propeller which was found at e first trial to be of such good form and proportions as to give excellent sults. His first vessel was the *Francis B. Ogden*, named after the United tates Consul at Liverpool, who had lent the inventor valuable aid in his ork. The boat was 45 feet long, eight feet beam, and drew three feet of ater. It attained a speed of ten miles an hour, and towed an American cket-ship, the *Toronto*, four and a half miles an hour on the Thames. his was a splendid success.

Ericsson built several screw-boats, and finally, meeting Captain Robert Stockton, of the United States Navy, that gentleman was so fully conced of the merits of Ericsson's plans that he ordered an iron vessel of 70 feet length and ten feet beam, with engines of 50 horse-power. The trial of the *Stockton*, in 1839, was eminently satisfactory. The vessel was sent to America under sail, and the designer was soon induced to follow her to this country, where his later achievements are well known. The engines of the *Stockton* were direct-acting, the first examples of engines coupled directly to the crank-shaft, without intermediate gearing, that we meet with after that of John Stevens. Soon after Ericsson arrived in the United States he obtained an opportunity to design a screw-steamer for the United States Navy, the *Princeton*, and, at about the same time, the English and French governments had screw-steamers built from his plans, or from those of his agent in England, the Count de Posen. In these ships—the *Amphion* and the *Pomona*—the first horizontal, direct-acting engines ever built were used. They were fitted with double-acting air-pumps, having canvas valves and other novel features.—[From "A Manual of the Steam-Engine," by Prof. R. H. Thurston; John Wiley & Sons, 53 E. 10th St., New York.

(To be continued.)

BLUE PRINTING.

The usual process of making blue prints is to coat one side of the paper, using for the purpose a brush or a sponge, with a mixture consisting of one drachm of the red prussiate, and one and one half drachm of the ammonia citrate of iron, dissolved in about one ounce of water. This amount of solution will be sufficient to coat several large sheets of paper, but it will not keep a great while after being coated. The surface is yellow when first coated, and after a week or so will have turned to a dirty greenish color. It can be used in this condition, but makes inferior prints. It is better to make up some fresh solution, for it only takes a few minutes to dry the paper ready for use after the coating has been spread on. Then a sheet of it is put under the tracing, and exposed to sunlight under a sheet of thick glass, or in a regular frame for making blue prints. After exposing until the parts of the paper not protected from the sunlight have turned to a kind of "greenish granite" color, the print is removed and washed in clear water until the yellow color stops coming from it. Then the print is hung up to dry.

In order to make a blue print with blue lines on a white ground, two methods are open. The first is to make a print which may be called a "negative," and then to make the blue line prints from that instead of from the drawing itself. The reader can readily see that if a print from a transparent sheet, with opaque lines thereon, will give a copy that is opaque with transparent lines, then by taking another print from the first print there will be opaque lines on a transparent ground again, similar to the original drawing. But there is one drawback to this method which is fatal to its success. That is, the blue print which is made from the original will not work when used as a negative, because being of a blue color the rays of light which shine through the color will affect the sensitive sheet fully as quickly as the rays which shine through the transparent or white paper. In fact, blue is one of the actinic colors, and likewise one of the most actively actinic of them all. Now, if the print taken for a negative could be black, yellow, red, or any of the non-actinic colors, there would be no more trouble in printing a blue print from it than there is in printing one from the original tracing.

It is in order, therefore, to look around for some means of making a print which will be non-actinic. To this end, it is best to get a sheet of "silver paper" from a photographer, or, what is easier, get him to make a print of the tracing on silver paper. Then, after that is "toned" and finished, it can be used as a negative for the making of as many blue line prints as may be desired. The other way of making a blue line print, or, in fact, one other way, is to make up a kind of blue print paper which will turn blue only where the sunlight does not hit it. This is a little different from the first kind of paper described, and the difference is that this kind is charged with chemicals which the sunlight has the power of destroying the color thereof, instead of setting the color, as in the case of the ordinary blue paper all ready described. For the present it will be sufficient to state that the paper is prepared by mixing together three solutions, then mixing the three into one when ready for use, and spreading it on the paper as if for a simple blue print. The three solutions are: Gum arabic, 6 drachms; water, 30 drachms; ammonia citrate of iron, 4 drachms; water, 8 drachms; perchloride of iron, 2.5 drachms: water, 5 drachms. As these things will keep separate, they can be mixed in larger quantities; for instance, taking ounces for drachms, then the quantity that is to be used at one time can be taken of each, let it be in drachms, half drachms or minims. The paper will also keep well after it is sensitized, so that a quantity may be made up at one time and kept from the light till needed. The reason that this kind of paper will keep, while the other will not, is because the common paper turns upon exposure to the light, while this kind will not turn, even in the developing solution, if it is exposed to the light. The paper is printed in the usual manner, then it is floated upside down on a solution of potassium ferrocyanide, one ounce; water, four ounces.

The paper must be floated on top of the mixture, because it will stain the back of the print if any of it gets thereon. After the lines get blue enough, as may be determined by turning up a corner of the paper occasionally, it should be removed from the "developer" and floated on clean water, which will at once stop the process of turning any darker. If there be any blue spots left on the paper where they don't belong, *i. e.*, except on the lines, they can all be cleared off by putting the sheet of paper in (no need to bother with putting on top this time) a solution of eight parts muriatic, three parts, sulphuric acid, with 100 parts of water. After the blue spots have disappeared, wash well in water, dry, and a print with rich blue lines on a white ground is the result. This kind of a print, the "blue positive" may be colored, something which cannot be done with an ordinary blue print.—[The Tradesman.

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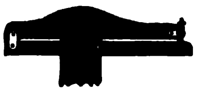

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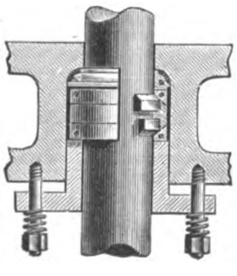

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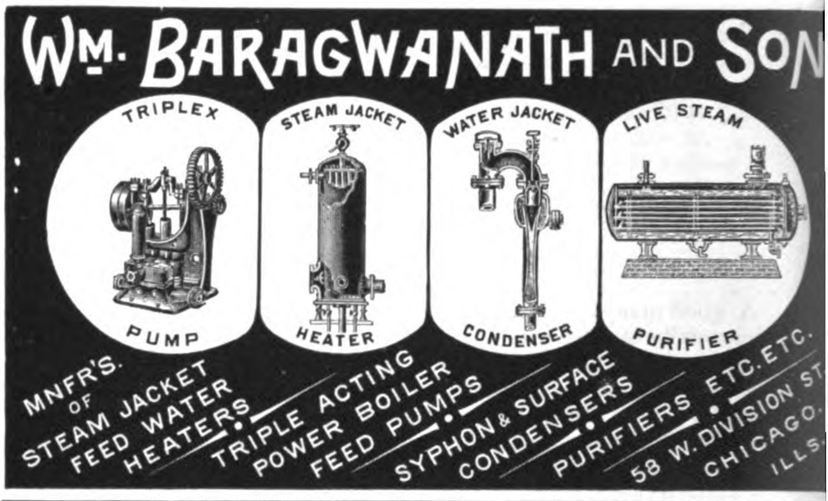

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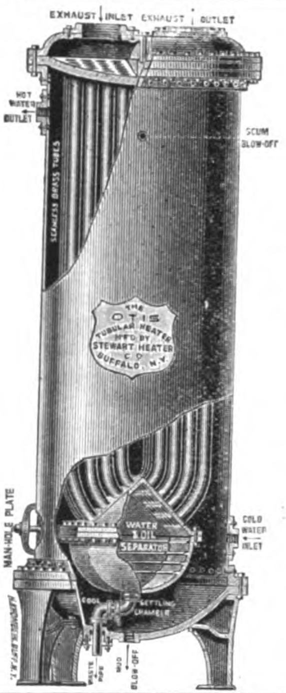

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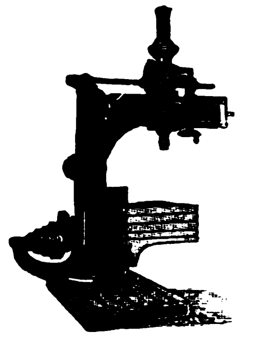

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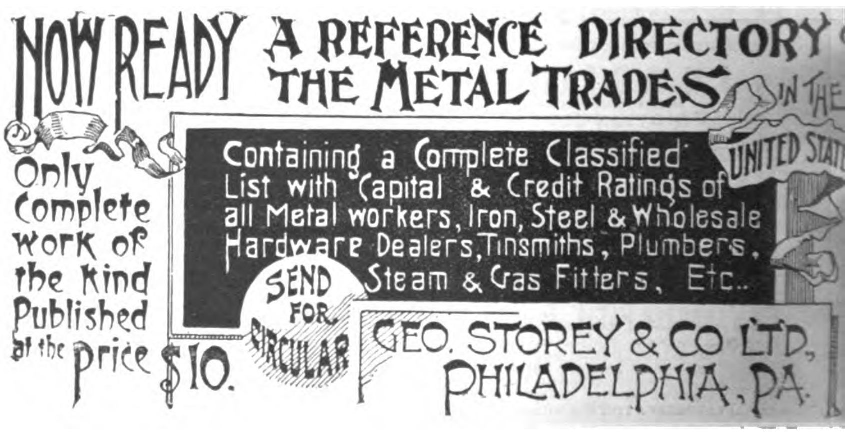

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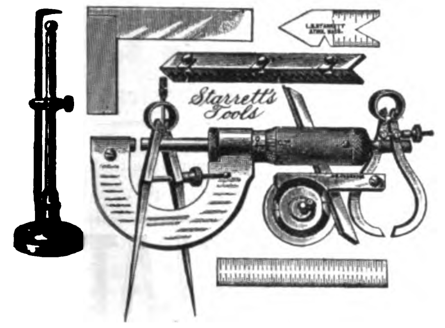

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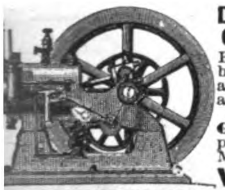

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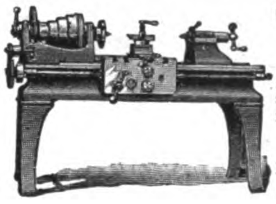

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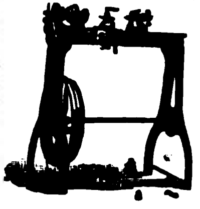

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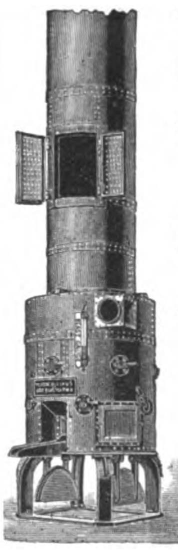

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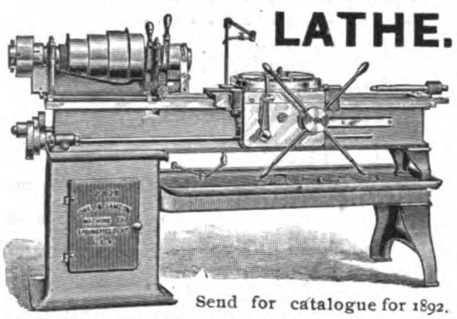

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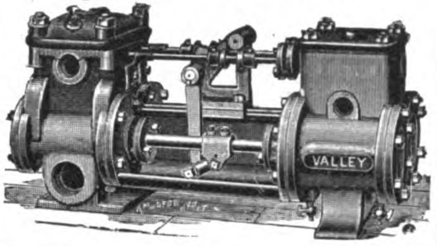

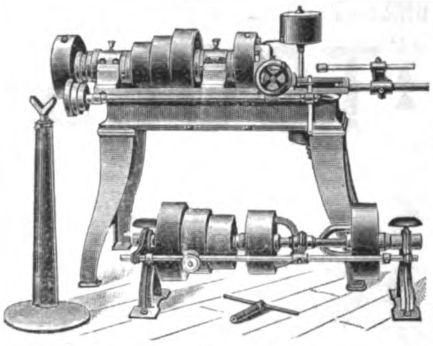

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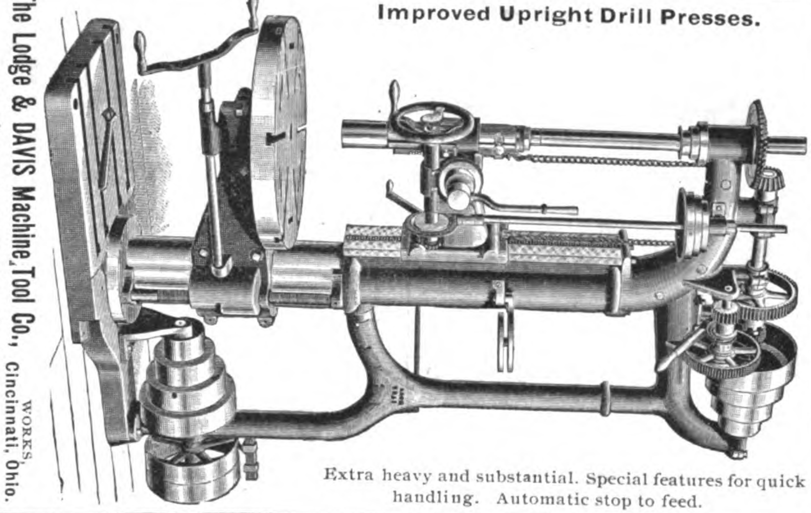

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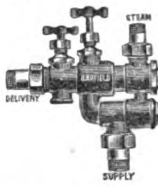

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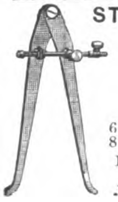

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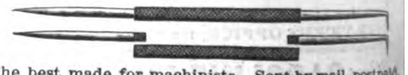

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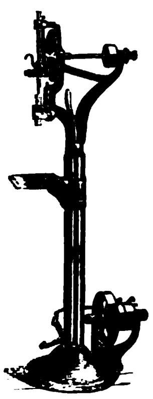

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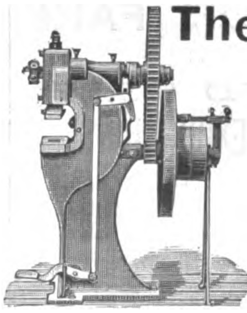

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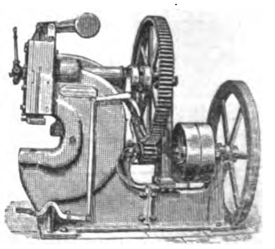

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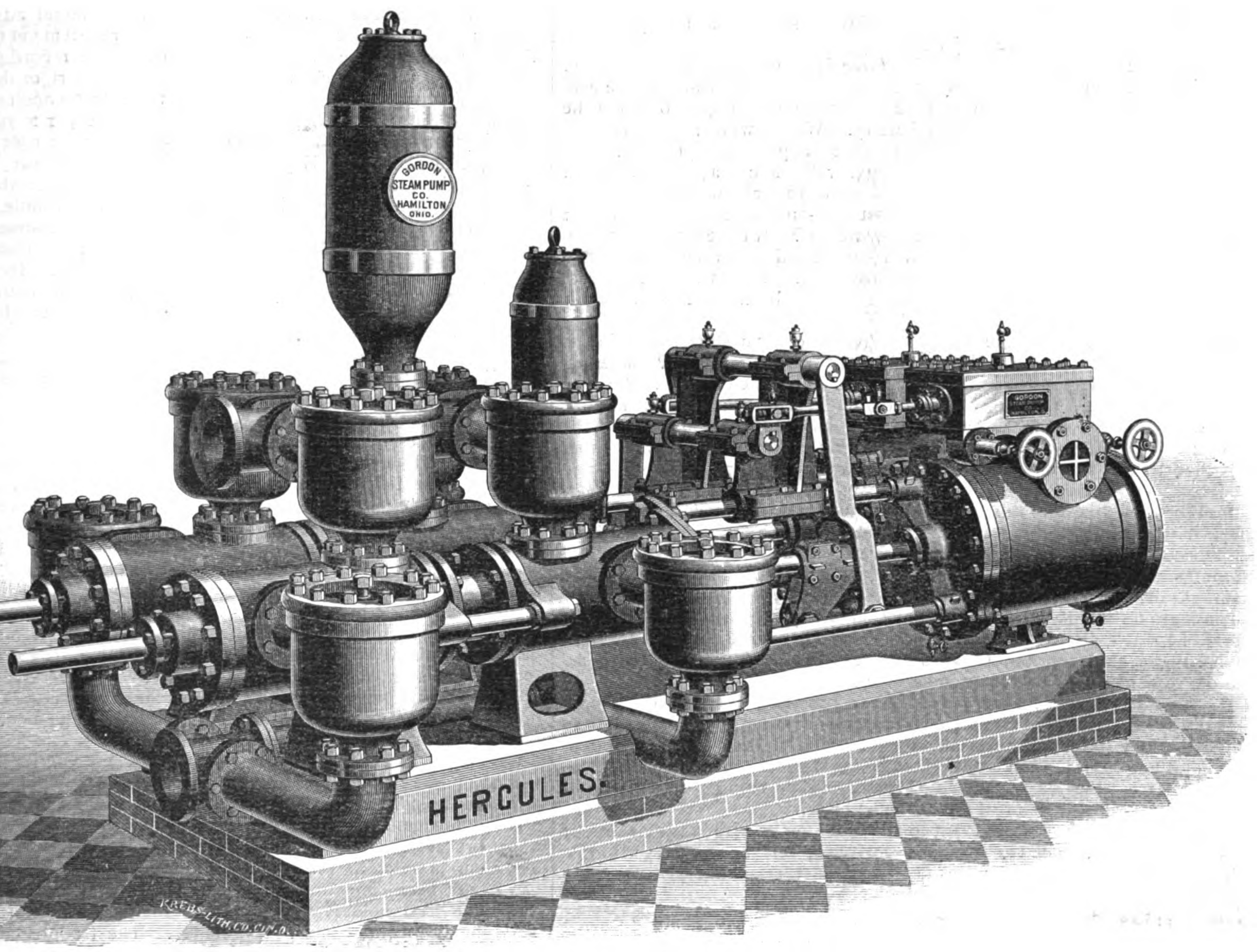
STABLISHED, 1882. CLEVELAND, O., SEPTEMBER 15, 1892. { VOL. X—NO. 18. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. TERMS:—$1.50 A YEAR, SINGLE COPIES, 7 CENTS.

HERCULES STEAM PUMP.

We illustrate herewith one of the many recent styles of pumping gines of the Gordon Steam Pump Co., Hamilton, O., builders of pumps every description.

The one shown is what they term their "Hercules" pattern, which is signed for heavy pressures. It is especially adapted for use in rolling ills, steel works, mines and for any place requiring pumping machinery operate against heavy pressures of from 300 to 600 pounds.

All parts of the pump are of great strength and all exposed to pressure e subdivided as much as possible in order to overcome the objection of ing required to replace the entire water end in case of rupture through cident or negligence. Each part being cylindrical in form it is well designed to resist the heavy pressures encountered. All parts are easy of access. The water valves are arranged in a series of valve chambers each chamber containing a number of small valves, guided both above and below with low lifts. The valves and seats are of gun metal, and the plungers are centrally packed externally.



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The pump described above can be built either non-compound, compound non-condensing, or compound condensing. They are now building four large duplex compound condensing pumping engines of this style. Each engine has high pressure steam cylinders 28″ in diameter, low pressure steam cylinders 50″ in diameter, pump plungers 9″ in diameter, the whole having 36″ stroke.

They Came into the World Full Grown.

A remarkable effect is produced on the mind of the manufacturer and mechanic when he read, how certain mechanical prints sprung, Minerva-like, into robust and mature existence, like the sun rising from the water, at a single leap, as it were. The reader naturally supposed that they reached their fine proportions and their firm footing near the top of the ladder, by slow and steady growth and by arduous, persistent climbing. He was under the impression that, like others, they were born infants, "mewling and puking in the nurse's arms," then, enduring successfully the critical complaints incidental to the milk-bottle stage, that they arrived at the station of childhood, and, thanks to the watchfulness of the good mother, continued to thrive, attaining successively the estate of youngster, boy and man. But to his surprise, he finds that they were, by some magic, or special dispensation of Providence, enabled to save all this nursing, training, building up and patient waiting, and to step at once into the ring, full-fledged gladiators of mechanical science.

He can't see how it happened, but does not doubt what he has read (?) However, his curiosity gives rise to a desire to look over the old files of those journals and behold the wonderful creations. If he is so happy as to have access to such files, which is not often the case, he will hardly be able to harmonize the appearance of the musty pages with the statements, but of course he does not place ocular evidence against the printed utterances, and concludes that journalism is truly a wonderful business.

"The Mechanic's Friend."

We have received a model of a steam engine called the Mechanic's Friend. It is a sectional model of a horizontal steam engine, 12″ long. By turning the crank pin handle, all the various movements of the steam engine can be readily seen, such as the lap, lead, cut-off, etc. It is for the use of amateurs, firemen, public and other schools, and any one who wishes to learn the movements of the steam engine, or to instruct others. It is made by The Mechanic's Friend Manufacturing Co., Milwaukee, Wis.

Electrical

The Storage Battery System of Street Railway Propulsion.

In discussing the present status of the storage battery system of electric street railway propulsion, there are three questions to be considered: (1) Why is it that so promising a field in electrical engineering has as yet produced no adequate commercial results? (2) What definite knowledge has been gained by the trials and failures of the past? and (3) What are the prospects for the future for the introduction of storage battery traction? In respect of the first question, I would say that patent litigation in which the subject of storage batteries has been involved is largely responsible for the failures in the past, although there are other causes which I will touch on presently.

This uncertainty of the ownership of the basic patents has rendered capital timid. Conservative street car companies could not afford to equip their lines with a system that might be adjudged an infringement of other patents, and upon which an injunction might issue at any time, and on the the other hand the battery companies have not been strong enough to equip and operate a line of sufficient magnitude to demonstrate the commercial success of their respective systems, or if they have been, they have failed to do so. I might add, also, that as a further result of this uncertainty as to the ownership of the patents, a large number of storage battery companies have sprung up in all parts of the country, without any reason for their existence beyond the fact that their promoters thought that it was only necessary to change the shape or form of a plate to escape the patents, and for the further purpose of selling stock to the innocent public. Many of these attempts show an utter ignorance and disregard of all the principles that are well known on the subject.

Hundreds of thousands of dollars have been squandered in this way, to the disappointment of innocent stockholders and the dismay of the general public, who, seeing so many failures, have come at last to doubt the possibility of a commercial storage battery. We, however, have nothing to do with this. The success or failure of an engineering problem, fortunately, does not depend upon what the general public may think about it, unless it be a problem requiring an enormous capital, which can only be obtained through the Government or by the co-operation of a large number of individuals. What, then, does it depend on? It depends on our ability to demonstrate that we can accomplish a desired result in a better and cheaper way than has heretofore been employed. This brings us, then, to our second query. What definite knowledge has been gained by the trials and failures of the past?

Assuming, for the sake of argument, that electric storage traction is practicable, what are the problems that confront the engineer? The first and most important is the life of the battery. (2) The capacity. (3) The rate of discharge. (4) The weight and size of the elements. (5.) The loss of power in the various transmissions between the prime mover and the axle; or, in other words, the relative efficiency compared with other methods. (6) The distance or total length of line. (7) The grades and curves. (8) The speed. We will not consider all these points separately, but the whole question in a general way. In traction work there is only one reliable method of determining the life of the battery, and that is on the basis of car mileage. It is nonsense to talk about batteries lasting eight months or eighteen months, unless there is a record at the same time of the amount of work accomplished, measured in electrical horse-power hours. The highest record yet obtained, that I have any reliable knowledge of, is that of a single set of 108 accumulators making over 6,000 miles. This record was made on the Citizens' Passenger Railway, in Indianapolis, under the most unfavorable circumstances.

Assuming that the battery could make 100 miles per day, this would mean that the battery would have to be renewed every 60 days. If 50 miles per day, then the life would cover a period of four months: and at 25 miles per day, eight months; so you can readily understand that the bare statement that a battery would last six or eight months does not convey a correct idea of the real life of the battery.

Let us see what it would cost to run 6,000 miles with a single set of accumulators, or, since two sets are employed, one being charged while the other is in service, we will make the calculation on a basis of 12,000 miles.

216 positive groups, at $2 50	=$540 00
Credit 2 592 pounds lead scrap at 3 cts	= 77.76
Balance	$462.24

462.24÷12,000=3.85 cents per car mile.

What amount of work is represented by this 6,000 miles, so far as the accumulators are concerned? It was found by careful records on the Fourth Avenue line, in New York, that the amount of energy consumed per car mile was about one and one half E. H. P. hours. That is to say, that after making a round trip of eleven and one-half miles, it required about seventeen E. H. P. hours to replace the energy drawn from the batteries. Six thousand miles would, therefore, require 9,000 E. H. P. hours, and since a battery of 108 cells has a capacity of 54 E. H. P. hours for each total discharge, if we divide 9,000×54 we get 166 discharges that are required of the battery before the positive plates break down. Any one who has had any extensive experience with storage batteries knows that this is a very conservative estimate of the amount of work that a good battery will perform. It may be asked, have there been no improvements in late years with a view of diminishing the number and weight of batteries required to propel a car? I regret to answer, no, and this brings me to the consideration of the limitations of storage batteries. I have said that it requires about one and one-half E. H. P. hours per car mile, and tha 108 accumulators are used and necessary for a 12-month run, and they hav a capacity of 54 E. H. P. hours, or three round trips. Why is it not pos sible to use a battery with one-third the weight? Simply because the weigh of battery required is not according to the total amount of work to be done, but according to the rate at which it is to be done. Let us go back to ou 12-mile run again. This requires one and one-half E. H. P. hours per ca mile, or, 1,119 watt hours, and since the E. M. F. is about 225 volts this would be equivalent to nearly five ampere hours per mile or sixty ampere hours for the round trip; and since the tri consumes two hours' time, this is an average rate of discharge of 3 amperes all the time. Of course, it is very much greater than this at times when the car starts or is going up steep grades, etc., when the battery i frequently called upon for a rate of discharge of over 100 amperes. Now if we were to use a smaller battery of less total capacity, there would no be sufficient surface area of active material exposed to develop such a cu rent; the E. M. F. would drop and the car stop running. This is th trouble with all thick plate batteries. The amount of surface area expose is comparatively small for the weight of battery.

The reports of the West End road in Boston for the months of Ma and June, 1891 show that the total cost of the overhead system was abou 21 cents per car mile, while that of the horse system was about 25 cent per car mile. These reports, showing the net results of the actual workin conditions on a very extensive scale, are far more accurate than any pape calculations based on theoretical and ideal conditions, as all the uncertain ties and unknown quantities always arising in actual operations are include in these results. Now, inasmuch as nearly all the electrical and mechanic conditions are constant in both the trolley and storage systems, with th exception of the overhead line and batteries (with some minor advantage favoring the storage system), if we can show that the additional cost of th batteries over and above the entire cost of the trolley system, does no exceed four or five cents per car mile, then it is manifest that the storag system will supersede the horse system, as the collateral advantages are s great as to render the consideration of any other system out of the question This, I think, we have already demonstrated by the record of the Indiana polis battery given, which is confirmed by the report of the Birminghan Central Tramway Co., Limited, wherein it is shown conclusively that wit only a small installation of five or six cars, it is cheaper to run with storag batteries than with horses. It appears that the total cost for storage batter traction in Birmingham, England, was 14.74 cents per car mile, and fo horse traction was 15.74 cents per car mile, and under the heading o repairs, the item of material is only 2.66 cents per car mile, and assumin that this was all for renewals of battery (although, of course, some of th expense must have been for repairs to motors, etc.) we find that the co of battery renewals was only 2.66 cents per car mile. In view of suc facts, is it possible to contend any longer that storage battery traction not commercial?—[Pedro G. Salom, in Franklin Institute Journal.

Testing Dynamos,

Electric business generally is done in a most unbusiness-like way. purchaser orders of a manufacturer a dynamo of a desired capacity; th purchaser gets the machine into position, puts the belt on, turns the switc and off she goes—that is, if she goes at all. If the dynamo does not sta off immediately and bring all the lamps and everything else in the circu up to the expected point of excellence, or if, for some simple cause, th dynamo doesn't "generate," it is at once condemned. The cause of th trouble may be an open circuit, or it may be the connections are not mad correctly.

There are a great number of reasons why a dynamo will not alway start up at once and all of these reasons should be looked into before judg ment is passed. I have seen engineers spend weeks to find the "pound in their engine and they did not "dam" the man that made the engin because it pounded. An engineer knows that there is a reason for it, an sets to work systematically to find the cause. But let a dynamo get out o order, and this same man will lose his head at once. I once went 15 miles to put a brush down on the commutator of a dynamo. An enginee of a certain plant in a large establishment in a sister city had been runnin a 1,200-light incandescent plant for more than a year. Finally when h started up one night one of his dynamos would not "generate." He ha "looked everywhere for the trouble," and gave it up. I was sent for and in a few moments, by a little systematic testing, discovered that th upper brushes did not touch the commutator by a small fraction of an inch The stem on which the brushes were mounted had become slightly loose an had turned back enough to lift the brushes from contact with the commuta tor. The brush holders were of the kind having a limiting stop each way The remedy was, of course, very simple. The trouble could have easil been found by the engineer had he used a little "horse-sense," and as have before said a little systematic testing. I do not mean by this, a serie of guesses, but tests based upon sound judgment. Go off in a corner an think it out, but do not hop around and try a dozen different things with out knowing the reason why you are doing them. It is seldom that troubl of this kind is cured accidentally.

I went to Milwaukee one time to find the trouble with a large Brush arc machine. The dynamo man said he had not been able to find the trouble, and that it had not worked for three days. It seems incredible when I relate the cause to have been that one section of the commutato

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d been removed and was missing. How the man in charge could have iled to discover it is more than I can understand, but he was ignorant of e fact until I pointed it out. If I thought that. it would make interting reading I could relate, I venture, at least, one hundred as ridiculous ses as these, where a little thinking and a general knowledge of the chines in charge could have saved time and money to the owners. I ll not attempt in this article to describe how these tests should be made order to locate trouble, for there are hardly any two cases alike. It will erefore be necessary to adopt a systematic method which I will endeavor present at another time. There are two sides to every story and the gineer or dynamo men are not always to blame. The owners of plants ould not look to them for all of the trouble that occurs until they have t performed all they should before the plant is given into their hands.

Every plant that is put in should be tes'ed, "received" and accepted an independent and competent electrical engineer, one who is in busis for himself and expects to remain so, so that he could give a fearless d honest opinion to his employer. He should closely examine the namo for capacity, insulation, continuous run, efficiency and an importt and often overlooked quality, mechanical construction. And then ne in a number of minor features which should be looked after, inductvelocity of the armature—it may be greater on a drum than a ring nature; rise of temperature on full load should receive close attention; steresis and Foucault currents are much more noticeable in badly conucted and proportioned machines than is usually suspected. I have own a case where these two ever present evils have absorbed more than per cent. of the power for the dynamo. The heating of switch contacts d other joints should be noted; the resistance of the circuits as a whole, d in sections, should be measured. In fact, every condition should be refully noted. If the dynamos are compounded, see that the rise with d corresponds with the loss in line, also be careful to note if there is re than one compound dynamo, whether the equalizer is large enough. e resistance of the equalizer should not be less than one-half of the resistce of the larger armature.

There are numberless points of this kind that should be carefully spected by a competent man before a plant should be accepted, and I lieve that if owners understood more of the importance of these seemingly tle points—but, in fact, very important factors to the success and econical maintenance of every plant—that there would not be so many tchers in the business manufacturing electric light apparatus today.—oree Bain, in Electrical Industries.

A Wonderful Machine.

A phonoscope is an instrument just perfected by M. Dumeny, of Paris, hich combines a number of instantaneous photographs of a person speakg in such wise that a deaf mute, expert at lip reading, can understand hat was said. The movements of a speaker's lips are so rapid that at least teen photographs a second must be taken to get a good result. The hole head and bust of the speaker is photographed in order to get the nefit of the expression. In the phonoscope the positives are arranged ound the periphery of a disc, which is rapidly turned by a handle. A cond disc having a single window in it just opposite the plates is also tated by the same handle, but at a much higher speed than the other. beam of sunlight illuminates the plates from behind, and the observer oking into the apparatus sees them pass his eyes one after the other in ch rapid succession as to produce the effect of a single image endowed ith animation. To this end at least ten or twelve must pass the retina in second. M. Dumeny is so far satisfied with his results that he looks forard to a time when we shall possess veritable "speaking likenesses" of r friends.—[New Orleans Picayune.

Solid Piston Valves.

The *Teutonic*, White Star steamer of the first class, when in New York me months ago, had the rings removed from the piston valves of her ennes, and directly afterward made her famous run, breaking the record om New York out. There is, no doubt, a good deal of lost power conmed by the friction of stiff piston rings. There is no way to prevent over ressure when adjustable packing is employed, and this is one of the main asons in favor of snap rings, or non-adjustable ones. It is a problem of tting, and the character of materials. Every one with much experience ill have at some time, if not many times, met with sliding joints under eam that show no wear or symptom of it. The fact is, we do not know ll concerning the wear of surfaces under steam, but do know that when ressure is inconsiderable, as in the case of piston valves of vertical engines, nd when the metal is uniform in respect to expansion, positively fitted arts do not wear. If a main steam cylinder, or a valve chamber can be bored true," and that means a good deal, and a piston can be made with certain fit therein, no change will take place, and friction will be entirely liminated.—[Industry.

A Tinplate Machine.

Leaving aside the question of economy in importing or manufacturing nplate, we have a very ingenious machine for its production, invented by Villiam Buckman, and being exploited by the American Tin Plate Machine Co. The black sheets from the pickling bath are fed into the achine, which scoures them with sand as they pass through and then ashes the plates thoroughly and dries by steam heat. The machine when desired) then fastens the cut sheets and forms a continuous roll, specially adapted for roofing purposes. The roll now passes through the lux and tin bath, which is covered with palm oil—a feature for which Mr. Buckman claims many advantages over existing methods.

The machine (of which several have been built and one ordered for Wales, so rumor has it) has a capacity of ten boxes of cut sheets per hour. There is no reason why American ingenuity should not bring tinplate making under its wing as well as other industries, and when the conditions are ripe and more study turned to that industry, it will flourish without the aid of a "fostering parent." It is a similar case to many small shops who make every bolt in the lathe when machine made bolts could be bought cheaper, but boasting that "they make everything themselves." When they are led to see the economy of a bolt machine (if their work warrants it) they are then practicing economy in making their own. This applies to any industry.—[N. W. Mechanic.

Cold Water in a Red Hot Boiler.

"In 1856," said an old engineer, "I conducted experiments which proved to me that putting cold water in a red hot boiler could not cause an explosion. At that time, and indeed, up to a comparatively recent date, the opposite theory was held. I did not try to reform the philosophy of engine operators in this regard, but sometime in the latter sixties I had an opportunity of demonstrating my position. We had been working up stairs for some time, and when the second engineer and myself went down, I smelled burnt gum. I asked the second to look around, which he did, and found some badly scorched places. I then suspected that the water had gone down in the boiler, and asked him to see if it had. He glanced at the gauge, and hurriedly opened the furnace door. Sure enough, the boiler was red hot. That fireman turned as white as bleached cotton and looked at me, perfectly horrified with fear. Several of the employes of the factory were around, and when I told the fireman to start the pump, they drew back at a safer distance. Jim (the fireman) would not do it.

"'We'll all be blowed into eternity quicker'n you say Jack Robinson,' he said.

"Stepping over to the pump, which for some reason had stopped, I started it, but when I turned around, not a man was in sight. Well, the boiler filled up, and there was no explosion. The only thing that it caused was a slackening of the speed of the engine.

"Yet there are a great many cold water men, and I suppose, always will be."

True Surface Plates.

When a set of surface plates is true, if their surface is thoroughly cleaned with a silk handkerchief or the palm of the hand, and one is applied to the other, it appears to float about as if on numerous frictionless rollers, the slightest touch being sufficient to move it. If one plate be slid on the other, applying sufficient pressure, they will be found to adhere together, the top one being able to hold up the bottom one with ease. This was at one time thought to be owing to atmospheric pressure, the plates being so true as to exclude the atmosphere. This, however, doss not seem to be the case, for in a lecture before the Royal Institution, Dr. Tyndall describes some experiments he made with some hexagonal Whiteworth plates, in a vacuum, and they showed both the property of adhesion and floating. The lower plate of the two weighed three pounds, and had attached to it a mass of lead weighing ten pounds, but still the plates adhered together. Dr. Tyndall supposes the adhesion to be caused by the molecular attraction of the numerous bearing points brought into contact through the truth of the surface of the plates.—[The Mechanical World, London.

A Low Priced Outfit.

"We had a picnic at Atlanta, Ga., a short time ago," said a tool builder the other day. "The technical school down there burnt some months ago, and they were purchasing machinery for the new one. The day that the bids were to be received was known by nearly every tool builder, and they came in force. Before the time closed for receiving bids, there was a regular national convention of manufacturers of machine tools and their agents. We all knew that with so many on the ground, the shaving down would be considerable, and none but low bidders went in. I remember frequently hearing the remark: 'Hello, there's so and so, just arrived. He is an outragous slasher. I'll have to put in another bid,' and off the speaker would go to revise his bid. The college people were sharp enough to ask for separate bids on every piece of machinery. The consequence was, every one went away with a very small order, and none with any other; and the college got their outfit at prices way below anything known before."

ARTICLES of incorporation have been filed by the Lodge & Shipley Machine Tool Co., Cincinnati, O., with a paid-up capital stock of $100,000. The new company succeeds to the plant and business of the Ohio Machine Tool Co., William Lodge, proprietor, and with Mr. William Lodge as president and general manager, and Mr. Murray Shipley, Jr., vice-president and secretary. They propose, in addition to the specialties they are now producing, to manufacture a line of turret lathes of new design, and embodying a number of the patented features contained in the motor gear lathe recently put on the market by the Ohio Machine Tool Co. In addition to the above the Lodge & Shipley Machine Tool Co. will manufacture a complete line of machinery for boring and turning pulleys, couplings, friction clutches, etc., from twenty inches to six feet in diameter.

RECENT experiments of a Glasgow firm show that in drilling a $\frac{13}{16}$ inch hole in mild steel, using a drill with flat sides, a pressure of 916 pounds was required to force it to its work, the speed being 136 turns per minute, and the feed 312 turns to the inch. Under exactly similar conditions a drill with feathered edges (relieved) required but 616 pounds pressure, showing a decided disadvantage in using the flat drill. This may be compared with our flat drill as against our twist drill.

THE decimalists say that the twenty-four hour day is doomed. The day is to consist of ten hours; the hour will be divided into ten decades, each of which will contain ten minutes, each minute ten seconds and each second ten flashes. Upon this basis a clock has already been constructed.

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It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

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HABITS OF THOUGHT.

In the routine of piece-work in a mechanic's life there is a repetition of physical exercise of comparatively small diversity. The small compass of his physical movements, and the sameness of them, are an index to his mental habits. Because every new act requires a new thought, while a repetition of an old act after a time becomes mechanical to a great extent. It is easier to repeat the same thing over and over, whether in mechanism, in vocal utterance, or in abstract intellectual problems. This has induced many in all departments of industry, as well as in the so-called professional branches of life, to adopt the imitative and repetitive and discard the progressive, for the ease of it. But there is a pleasure lost in this sort of living, a pleasure which belongs exclusively to progressive genius. Life becomes stale if not spiced with a variety of thought and action. The advantages of a one piece man therefore, who does the same work over and over daily, hourly, or oftener—the advantages of such a man for broadmindedness are very meagre indeed. He lives the full breadth of his life perhaps in one second of time, and this marks his intellectual worth or greatness for the moment.

The best way out of the rut of a narrow life of this sort is always by the right kind of literature. A book or paper which will give the piece mechanic a knowledge of the whole line in which he is engaged, will not only make him capable of working in other branches of his shop or factory, but will give him so much more field of thought; which never fails to entertain the person, and strengthen the character. There are those who "scatter" their *efforts* too much to be sure, but none there are who branch out too far in relative lines of thought for strengthening their grasp of the one department of industry to which they are adapted.

Scientific reading, as well as novel reading, becomes fascinating by habit. Those who contract the habit of reading novels get to regarding thought as injurious and pursuit of knowledge as laborious and unhealthful. "As if it would hurt any one to think!" exclaimed Dr. Wheeler, of Meadville, in one of his lectures to young men. And yet some people often say that they use so much of their strength in manual labor and office business that they are too tired to read anything that will benefit them. But when they have become habitual readers of mechanical or other technical works they conclude that reading and thought is a recreation when interspersed with other toil. Literary work is the complement or relief of a toiler's life, and whoever neglects it will miss a part of his life and become a one-sided selfish man with all his impulse running to the gratification of his animal nature.

There are those who even discourage thought by hoarding up their ideas and depriving others of the benefit of their experience. We sometimes meet a manufacturer or a foreman or an old engineer or a mechanic of some sort, who says, "I don't *want* people to know my process," or "I would rather keep my discovery a secret." Such men never attain a very high standard of excellence because they fail to get the interchange of thought which would assist them to rise. It takes an Edison, Westinghouse, Nikola or Thurston to become great in their line. These men are all believers in hard work, interspersed with thought based upon the thoughts of others.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical scientific subjects of a practical nature and of general interest will receive attention. writer must give his name in full, but nothing that may identify him will be published a question if he requests his name withheld. It will give the editor pleasure to assist, thro this column, all readers, if possible, and he cordially solicits practical queries.]

(430.) John H. Yerks, Jamaica Plain, Mass., writes: "Is there a way to arrive at the nominal horse-power of an engine without goi through the usual course, or rather, without knowing the pressure und which it is to be operated, but simply knowing the size of the cylinder *A.*—The only certain method of ascertaining the work an engine will d to get the pressure by the use of an indicator, and figure it as we have f quently instructed engineers in these columns. If you wish to arrive a the nominal horse-power by approximation, square the diameter of the bo of the cylinder and divide by four. This generally comes very nea the accurate figure.

(431.) C. P. J., Bridgeport, Conn., asks: "How should a test fo leaks upon an arc or incandescent circuit be made?" *A.*—The circuit must be entirely separate. Disconnect the dynamos from the leads in either circuit. In an arc circuit break the line at the farthest point away, then place one terminal of magneto bell to one lead and the other to the ground. If there is no leak the bell will not ring. Do the same with the other lead. Next, place both bell terminals to both leads, while broken. If the bell rings on either set of circuits, cut the line into sections at lamps, from farther end, and test as before, for each section separately. Test incandescent circuits the same, all lamps being off and the main switches on.

(432.) W. Y. R., Denver, Col., asks: "What may cause a commutator to burn out?" *A.*—Many things, the most common, perhaps, being uneven segments, causing sparking when carrying an extreme load.

(433.) Oscar Pearins, Decatur, Ill., writes: 1. "How may hot bearings in a dynamo be remedied? 2. Why is a resistance lamp placed on a dynamo?" *A.*—1. If the dynamo is properly set and in line, and the bearings are of good material, smooth and even, the trouble may be with the lubrication. See that the oil cups are not clogged, make sure that the oil is feeding, and if possible reduce the load to give the oil a better chanc to remedy the trouble. 2. To indicate the general condition of the current

(434) Engineer, Los Angeles, Cal., asks: "How can I find th number of gallons of water a cylinder will hold?" *A.*—Get the square o the diameter of the piston in inches and multiply by the length of th stroke in inches. This multiplied by .0034 will give the capacity in U. S standard gallons.

(435.) C. L. Green, Foxburg, Pa., writes: "Will you please inform me through your 'Questions and Answers' how to mix the sand an what to mix it with and please state the proper quality of sand to be use for molding brass, also how to melt old brass in small quantities?" *A.*—Use a fine grade of molding sand. No mixing is required, but the san should be thoroughly "riddled" or pulverized. To melt brass you mus have a crucible, and a furnace. To get the heat you must have a cok fire. With the above arrangements you can melt any kind of brass, old o new.

(436.) A. W. McCarty, Rockoak, W. Va., writes: "Please giv me the names of the technical, mechanical or machinery schools of th United States?" *A.*—The list is so numerous that we are obliged to refe you to the Commissioner of Education, Washington D. C., whose report wi be sent you on application. See this report, pages 1154 to 1157. Ther are other schools besides those mentioned by the Commissioner of Educatio

(437.) "A Subscriber," Loomis, Neb., writes: "I am running Corliss engine and the shaft is connected with a face coupling to the lin shaft, which is about 40 feet long. Would like some instructions in regar to lining a shaft thus connected. 2. What is the best and cheapest packing for man-hole plates?" *A.*—1. To line up your shafting you must se first that the crank shaft is in line. There are various methods of ascertaining this. One is to run a line through the center of the cylinder an beyond the crank. Turn the engine on its outer stroke until the cran pin touches this line, and mark where it touches. Then turn the engine o its inner stroke and mark where the pin is touched the same as before. I the line touches the pin in the same place on both outer and inner strokes the shaft is in line. If not, the distance of the points where the pin i touched from the collar of the crank will determine which way the cran shaft is out of true and can be trued accordingly. When the crank shaft i in line the mill shaft can be made so. 2. Lead gaskets are the cheapest i the end, but hemp costs the least originally.

(438.) "Subscriber," Des Moines, Ia., writes: "Will you pleas give me the best method for tempering tools for hand brass turning (cast brass)? I have been heating to a cherry red and plunging into linseed oil which is very good, but would like something better. Will some brothe hand brass turner give us some instructions on this very important point?" *A.*—We would advise you to plunge it vertically into soft water hardene with lime. Perhaps some reader will, in response to your request, giv you a better method.

(439.) C. A. H., Salem, N. C., writes: "We have had considerable trouble in regard to balancing some cones that we are building, an would like to get full information direct from you, if possible, in regard t same. The cones are about 27″ long, 12″ diameter at one end, 7″ at th other, in head a 1 7-16″ shaft is secured. We find considerable difficult balancing these cones, so they will run smooth. When we get one end lanced, the other seems to vibrate. We would like to get the best thod for balancing a cone or cylinder of this kind. The cones referred are to make 1,000 revolutions per minute, therefore if there is any differce in the way of balancing these cones with different speeds, we would e to know it. The cones will weigh about 501 pounds each and have arings on each end." *A.*—We judge from the dimensions and weight your cones that they are solid iron. We can suggest only one way to ance a solid cone. The shaft should go through it, and the bearings ould be as frictionless as possible. When this is done and the cone will nain at rest at every point, the only way we know of to balance it more fectly is to speed it up to 1,000 revolutions, or more if possible. At s speed its eccentricity will be apparent, and by gently turning towards revolving surface a screw with pencil or chalk attached, until the htest touch is perceptible, the heaviest side will be marked. By add- metal to the lightest parts until the mark or line around the cone is of ial strength, a more perfect balance can be secured. This is a nice ce of work, for at 1,000 revolutions per minute an ounce more weight one side than the other will cause a vibration, but patience and skill can cessfully accomplish it. Readers are invited to give the inquirer any ormation of value to him of which they may be possessed.

☞ Readers are cordially invited to send us any questions, comment, ormation, ideas or corrections that suggest themselves while reading the Questions and Answers." The time to do it is when it is in mind. If e puts it off he is very likely never to get at it. Now is the best time. l communications are appreciated.—[Ed.

STEAM ENGINEERING OF ELECTRIC LIGHTING PLANTS.

It has frequently been said that electrical engineering is nine-tenths chanical and one-tenth electrical. The approximate truth of this statent is now becoming evident in the construction of the most recent central station" plants for the electric lighting of large cities. The diffilty of making these decisions and of completing the general design of plant is enhanced by the fact that the mechanical engineering of eleccal lighting plants is now in a transition state, and there is scarcely a ant in existence which can be safely taken as a model for new designs. the electrical part of the problem there is less difficulty, for the reason at the principal element in it, the dynamo, has already reached a remarkly high efficiency, and the electrical data as to wiring, insulation, etc., e so well known to electricians that they are not apt to make any serious istakes in their choice of types or sizes of dynamos or in their systems of iring.

In all branches of engineering there is a tendency toward a permance of type and a unification of design following a period of tentative ort and variety. For instance, in marine engineering 30 years ago there re numerous types of boilers and of engines. Now in the best practice e Scotch form of boiler and the inverted vertical compound or triple pansion engine is in almost universal use. In locomotives there is markably little variety, what is known as the American locomotive havg resisted all attempts to materially change its general character for more an 30 years. In bridges of moderate span the span-connected bridge in is country is almost universal, departures from this type being made only cases of exceptionally long spans or for architectural reasons.

The business of electric lighting is becoming one of enormous magnide. As the great cities increase in wealth even faster than they increase population the former luxury of the electric light is becoming almost a cessity, and people are continually using it with greater extravagance. central station plant therefore of necessity becomes a vast establishment, quiring an equipment of thousands of horse-power of boilers and engines, id demanding the utmost skill of mechanical engineers to make it efficient id profitable.

In chimneys, for instance, the variety ranges from the small and cheap on stack to the vast brick pile, which has been well called a monument to e folly of its builders. In boilers every conceivable type of ordinary ationary boiler is used, and some engineers, not satisfied with the best iown land boilers, are seriously considering a type which has as yet found field of usefulness on steam yachts and torpedo boats only. In engines e range is from the triple-expansion Reynolds-Corliss engines, at Provience, with a record of less than 13 pounds of water per horse-power per our, to the high-speed single-valve single-cylinder engine, whose water nsumption is only guessed at. In connections between the engine and namo we have belts, leather, rubber, cotton, and leather links, rope ives, friction clutches, friction cones, and various patented systems of insmission, with belt tighteners and other like means of wasting the wer of the engines.

One of the conditions of electric lighting which makes the selection of e steam plant a matter of peculiar difficulty is the fluctuation in the quany of work done. The maximum work is required during only a few urs in the evening. As both boilers and engines have but a limited nge of capacity in which they approximate their maximum economy, a crease in economy taking place both when they are over-driven and ien under-driven, it is a matter of fine calculation to determine what gine, and what combination of boiler and engine, and what steam presse for such combination, will give the highest economy for the whole time running, rather than what will give the highest during the period of aximum work only. A similar calculation is also needed to determine hether, with a given cost of coal per ton, it pays to put in a triple-expann engine, with its known economy of fuel for maximum loads, if it is to at its most economical rate for only three hours out of every 24.

Another difficult point to determine is for what time during the crease of load below the maximum it is advisable to let all the engines and boilers work with a gradually decreasing load, and when to shut down one or more of the engines and boilers. Careful observation in running plants and continuous testing and recording of results will be needed before any general principle can be laid down on these points.

In the matter of steam boiler performance much dissatisfaction exists because continuous records of water and coal consumption indicate far less economy of coal than would be estimated from records of individual boiler tests during a period of ten hours of expert testing. The reason of the apparent loss is probably that the conditions prevailing during the tests of a single boiler are not the same as those prevailing in a large plant of boilers running continuously, especially as regards force of draught and its equalization among several boilers. It is frequently found that in a row of boilers some may have too much draught causing excessive waste of heat in the chimney, and others too little, causing imperfect combustion and excessive percentage of loss by radiation. Much care is needed to cause the condition under which a boiler is used in actual service to approximate those existing during a test. A pyrometer should be used with each boiler to indicate whether or not there is excessive waste of heat in the flue gases.

One of the most expensive items in the cost of an electric lighting plant in a large city is that of the land and buildings, and the increasing cost of this item is likely to control in future to a great extent the selection of the type of boiler and engine. The water-tube boiler, giving exceptional advantages in compactness as well as in ability to carry high pressures of steam in safety, is likely to become the permanent type for all large plants. The multipolar dynamo, capable of being run at moderate speeds, is offering great advantages in the direction of economizing space by reason of its ability to be placed on the engine shaft without the intervention of pulleys, belts, friction clutches, jack-shafts and other encumbrances. The vertical type of engine is also likely to become the favorite chiefly on account of its saving of ground space. Compound and triple-expansion engines are likely to be adopted almost universally on account of their economy of steam, unless in locations where coal is cheap. Their more general use should also result in reduction of their price, which now seems excessive as compared with single cylinder engines. Forced draught has not yet been adopted to any great extent in electric lighting plants, but as it has come into somewhat general use on the Atlantic steamers, where saving of space is a prime requirement, there seems to be no good reason why it should not be adopted in electric lighting plants.

Before any general change in the direction of permanency in the type of steam engineering equipment of electric lighting plants can be expected, however, there must be a more general testing of the efficiency of the various kinds of equipment now in use, covering the efficiency of the boiler, as shown by the water it evaporates per pound of coal, of the engine, as shown by its steam consumption per indicated horse-power, and of the combination of the engine and the dynamos, as shown by the electrical horse-power generated by the dynamo in comparison with the indicated horse-power of the engine. It is to be hoped that there will be a series of tests made at the World's Fair of the efficiency of these various elements and combinations, and they should do much toward establishing that permanency of type which has been reached in many other branches of engineering.—[Engineering and Mining Journal.

Electricity at Homestead.

Electricity figured to some extent in the great strike at the Homestead, Pa., steel mills. It is said that preparations were made to defend the works by stringing wires above the high board fence surrounding the mills, and connecting these with dynamos, so that intruders could receive a powerful intimation that their presence was not desired. After the Carnegie Co. had succeeded in getting some men to go to work, one of the officers said this: "The rate of pay for the new men will be increased in proportion as the number of hours is increased, so that no injustice will be done them. The old open-hearth mill may be abandoned altogether, and, in any event, at least fifty of those formerly employed there will find their places filled by automatic electric motors now being manufactured by the Westinghouse Company." Thus it will be seen that electricity plays a part even in labor troubles.—[Western Electrician.

Where to Locate New Factories

Is the title of a 150 page pamphlet recently published by the Passenger Department of the Illinois Central Railroad, and should be read by every mechanic, capitalist and manufacturer. It describes in detail the manufacturing advantages of the principal cities and towns on the line of the Southern Division of the Illinois Central and the Louisville, New Orleans & Texas Railroads, and indicates the character and amount of substantial aid each city or town is willing to contribute. It furnishes conclusive proof that the South possesses advantages for the establishment of every kind of factory working wool, cotton, wood or clay. For a free copy of this illustrated pamphlet address Mr. J. F. Merry, Assistant General Passenger Agent, I. C. R. R., Manchester, Iowa.

The office of the *Machinery Moulders' Journal* will be removed to Pittsburgh, Pa., September 10th, John A Penton having retired from the management of the organization. The *Journal* will hereafter be under the control of W. G. Wilkes. All communications, papers, etc., should be addressed to *Machinery Moulders' Journal*, 86 4th Avenue, Pittsburgh, Pa.

In "A Chapter in Meteorological Discovery," in the October *Popular Science Monthly*, Mr. John Coleman Adams presents Benjamin Franklin as the father of American Meteorology, and shows the part which Redfield, Espy, Dr. Hare, Prof. Loomis, Blodgett, Mitchell, Coffin, and Dr. Joseph Henry have severally had in building up the science.

Engineers will do well to examine carefully the "Soot Sucker" on page 13.

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*From the Engineering and Mining Journal.

STRUCTURE OF THE STEAM-ENGINE.—I.

BY PROF. R. H. THURSTON.

Some Stationary Engines.

The structure and uses of the steam-engine have been well defined and mutually adapted, each to the other, since the middle of the nineteenth century; and in such manner as to have led to the production of certain fairly definite forms of engine; which are each employed very generally, sometimes exclusively, for equally specific purposes.

Thus: The modern mill-engine, simple or compound, is commonly a direct-acting, horizontal engine—at least for moderate and large powers—with effective provision for adjusting the point of cut-off by the action of the governor; the engine employed especially to drive fast machinery is commonly a machine having a "positive-motion" valve-gear and as simple of construction, as compact, and as well balanced as the art of the builder can make it; while the locomotive and marine engines are each of a type which has been the product of years of change and of evolution which have resulted in their very perfect adaptation to their peculiar work. It has thus happened that engines are divided into classes; each class having its characteristic form and structure, and its own special nomenclature.

According to Weisbach's system, the various piston-engines may be grouped under the following classes:

I. According to the number of cylinders: (1) Single cylinder. (2) Multiple-cylinder engines.

II. With reference to the construction of cylinders: (1) Fixed cylinder. (2) Movable cylinder. In the first case the engines are—(*a*) Vertical. (*b*) Horizontal. (*c*) Inclined. In the second case, they are—(*a*) Oscillating. (*b*) Rotary.

III. With reference to the action of the steam: (1) Single-acting. (2) Double-acting.

IV. With reference to the transmission of steam-power: (1) Direct-acting. (2) Indirect-acting. And in the latter case either—(*a*) With balance lever, or beam. (*b*) Without lever or working beam.

Steam-engines classed according to their purpose and use, as in the following scheme, may be taken as practically including all existing standard and approved types.

Standard types of engines; general class:

Stationary, or Mill, Engines: Moderate speed or high speed.

Agricultural Engines. Pumping Engines. Crank and fly-wheel. Direct-acting.

Portable Engines and *Semi-portable Engines. Steam Fire-engines. Road Locomotives. Railway Locomotives. Marine Engines.* Paddle-Engines. Screw-engines. *Special Types.*

In the first classification—that by reference to proposed use—the title is sufficiently indicative of its own reason and meaning; and this is commonly the case with the nomenclature based on structural characteristics. A simple engine does its work in a single cylinder; while a "compound or multi-cylinder engine has two or more cylinders," so connected "in series" that the steam exhausted from one shall be successively worked, under decreasing pressures, in the others.

Direct-acting engines are directly connected from head of piston-rod and the cross-head to the crank; beam-engines have a "working-beam" interposed; and the geared engine drives its load—as the screw-shaft in marine engines—by means of pinions on the crank shaft and gears on the screw shaft; thus enabling the latter to be driven at higher speed than the former, or, in very rare instances, the reverse. Vertical, inverted, horizontal, or inclined engines are so named to indicate the direction of their "center-lines" and their position. Condensing and non-condensing engines are distinguished by the fact that the latter possesses a condenser. The condenser, however, is not always made to produce a vacuum, when high steam-pressures are adopted; it is occasionally worked at atmospheric pressure, and is then simply either a heater or an expedient for securing pure feed-water for the boilers.

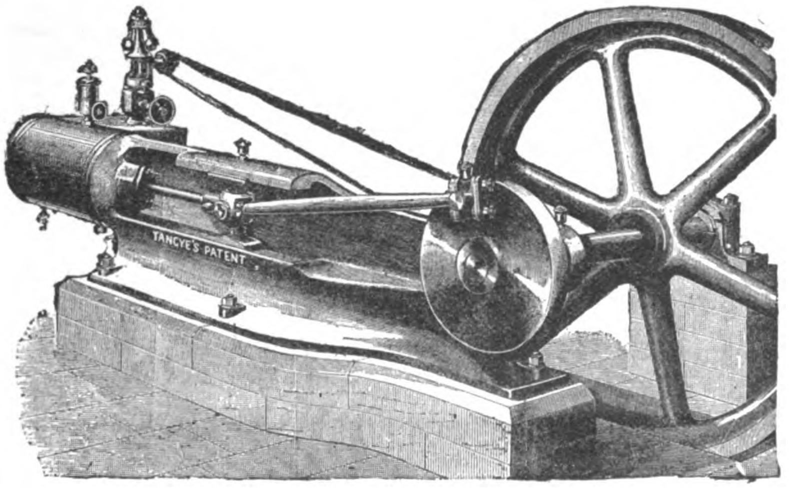

FIG. 28.—STATIONARY ENGINE.

Reciprocating engines are those—the usual type—in which the piston moves backward and forward in a true cylinder; vibrating engines constitute a rare type in which the piston swings in an arc inside a cylinder of appropriate form; while rotary engines are those in which the piston continuously revolves on an axis, usually parallel to its own plane.

The classification adopted by the author as that which will be followed in the arrangement of this work is the first, as presented in the table above; but separate articles or chapters will be devoted to such modifications as are comprehended in the other methods of classing engines falling unde those heads.

* * *

The Stationary Engine has a variety of forms, differing with the specia nature or with the location of the machinery to be driven. It is usually simple engine; but is getting to be more and more frequently "com pound," or even "triple-expansion;" it is usually driven at moderat speed, and has a "detachable valve-gear" or "drop cut-off;" but it i often of the high-speed type, with a positive-motion valve gear and a shaf governor. Among the most common forms are:

(1) The Mill-engine; (2) the Pumping-engine, and others of the mod erate low-speed class; (3) the High-speed Engine, of various kinds, b mainly used for mills or electric-lighting establishments; and a few peculia forms that need not be here considered.

Each of these types or forms is built both simple and compound; th latter will be specially considered in a distinct chapter.

The best known and most generally used class of stationary engines the present time, as has been stated, is that which has the so-called "dro cut-off," or "detachable valve-gear." The oldest well-known form valve-motion of this description is the Sickels cut-off, previously mentione patented by Frederick E. Sickels about the year 1841. It was introduc by the inventor in a form which especially adapted it to the beam-engi used on the Eastern waters of the United States, and was adapted to st tionary engines by Messrs. Thurston, Greene & Co., of Providence, R. I

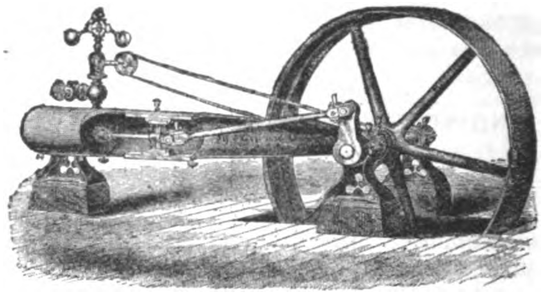

FIG. 29.—HORIZONTAL STATIONARY ENGINE.

who employed it for some years before any other form of "drop cut-of came into general use.

The Sickels cut-off consisted of a set of steam-valves, made indepen ent of the exhaust-valves, and each raised by a catch, which could thrown out, at the proper moment, by a wedge with which it came in co tact as it rose with the opening valve. This wedge, or other equivale device, was so adjusted that the valve should be detached and fall to seat when the piston reached that point in its movement, after tak steam, at which expansion was to commence. From this point, no ste entering the cylinder, the piston was impelled by the expanding vap The valve was usually the double-poppet. Sickels subsequently invent what was called the "beam-motion," to detach the valve at any point the stroke. As at first arranged, the valve could only be detached dur the earlier half-stroke, since at mid-stroke the direction of motion of t eccentric-rod was reversed and the valve began to descend. By introd ing a "wiper" having a motion transverse to that of the valve and catch, and by giving this wiper a motion coincident with that of the pist by connecting it with the beam or other part of the engine moving w the piston, he obtained a kinematic combination which permitted the val to be detached at any point in the stroke, adding a very simple contrivan which enabled the attendant to set the wiper so that it should strike catch at any time during the forward movement of the "beam-motion."

On stationary engines, the point of cut-off was afterward determin by the governor, which was made to operate the detaching mechanis the combination forming what is sometimes called an "automatic" cut- The attachment of the governor, so as to determine the degree of exp sion had been proposed before Sickel's time. One of the earliest of th contrivances was that of Zachariah Allen, in 1834, using a cut-off val independent of the steam-valve. The first to so attach the governor t *drop cut-off* valve-motion was George H. Corliss, who made it a feature the Corliss valve-gear, already referred to, in 1849. In the year 1855, T. Greene introduced a form of expansion-gear, in which he combined range of the Sickels beam-motion device with the expansion-adjustm gained by the attachment of the governor, and with the advantage of slide-valves at all ports—both steam and exhaust.

Many other ingenious forms of expansion valve-gear have be invented, and several have been introduced, which, properly designed a proportioned to well-planned engines, and with good construction a management, should give economical results, little, if at all, inferior those just named. Among the most ingenious of these devices is that Babcock & Wilcox, in which a very small auxiliary steam-cylinder piston is employed to throw the cut-off valve over its port at the instan which the steam is to be cut off. A very beautiful form of isochron governor was used on this engine, to regulate the speed of the engine determining the point of cut-off.

In some forms of Wright's engine the expansion is adjusted by movement, by the regulator, of cams which operate the steam-valv that they shall hold the valve open a longer or shorter time, as require

The older forms of stationary engines were usually simple in de of plain construction, durable, economical in first cost and in maintena but, as compared with more recent engines, wasteful of steam and But little space need here be given to their description. They were e beam-engines or direct-acting, and their valves and gear, from the quarter of the century, consisted often of a single three-ported slide- like that of a modern locomotive, driven by a single eccentric and e ing the desired expansion and compression of steam by the lap and le the valve, in a manner to be described in a succeeding chapter. beam-engine gradually fell into disfavor, on account of its size and nd was displaced very generally, by the middle of the century, by the orizontal direct-acting engine; and the increased steam pressures and mproved economy of the non-condensing engine also resulted in the ncreasing employment of that form of machine, to the exclusion of the ondensing engine, which is, however, still much used, especially for large owers.

Where economy was particularly sought, the engine was often fitted ith a separate cut-off valve, often mounted on the back of the main valve; ometimes, however, as a distinct organ in its own valve-chest. In the ost common system—that of Mayer—this cut-off valve consisted of two locks sliding on the back of the main valve, actuated by an independent ccentric, and capable of being separated or brought together, as desired, y a right and left screw, in such manner as to vary the point of cut-off to ny required extent. The eccentric is set with or 180° from the crank, ccordingly as the cut-off is effected by the inside or the outside edges of he cut-off blocks.

Where much power is required, the stationary engine is now usually a orizontal direct-acting engine, having a more or less effective cut-off valve-ear, according to the size of engine and the cost of fuel. A good example f the simpler form of this kind of engine is the small horizontal slide-valve ngine with the Meyer system of valve-gear. This form is a very effective achine, and does excellent work when properly proportioned to yield the mount of power. * * *

The engine shown in the accompanying illustration (Fig. 28) is an xample of an excellent stationary engine, and is simple, strong and efficient. The frame, front cylinder-head, cross-head guides, and crank-shaft plumber-block," are cast in one piece. The cylinder is secured against he end of the bed-plate, as was first done by Corliss. The crank-pin is et in a counterbalanced disk. The valve-gear is simple, and the governor ffective and provided with a safety device to prevent injury by the breakng of the governor-belt. In this example all parts are made to exact size y gauges standardized to Whitworth's sizes.

With many engines (as is seen in Fig. 29) two supports are placed—he one under the main bearing, and the other under the cylinder—to take he weight of the engine; and through them it is secured to the foundaion. A valve is sometimes used consisting of two pistons connected by a od and worked by an ordinary eccentric. By a simple arrangement these istons have always the same pressure inside as out, which prevents any eakage; and they are said always to work equally as well and free from friction under high as under low pressure.

Engines of the class just described are especially well fitted, by their simplicity, compactness and solidity, to work at the high piston-speeds which are gradually becoming generally adopted in the effort to attain increased economy of fuel by the reduction of the immense losses of heat which occur in the expansion of steam in the metallic cylinders through which we are now compelled to work it.

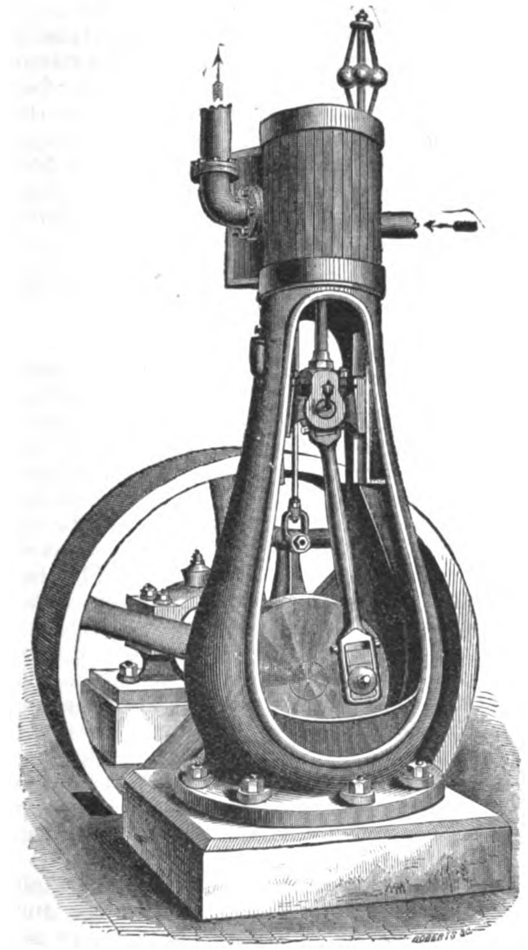

FIG. 30.—VERTICAL STATIONARY ENGINE.

The technical expressions "right-hand" and "left-hand" engines are thus defined as applied to the engines of this class:

Stand by the end of the cylinder, face the shaft and observe the position and direction of the main driving-pulley, and class the engine as follows:

Right-hand engines have the main driving-pulley on the right of the observer. Left-hand engines have the main driving-wheel on the left of the observer.

Forward-running engines move the top of the main driving-pulley away from the observer.

Backward running engines move the top of the main driving-pulley towards the observer.

In deciding on the direction in which an engine is to run, it is well to remember that forward-running engines are preferable, on account of the thrust of the connecting-rod being received on the lower guides, which are always stiffer and better lubricated than the upper.

One of the neatest and most modern designs of stationary engine for small powers is seen in Fig. 30, which represents a "vertical direct-acting engine," with base-plate—a form which is a favorite with many engineers.

The engine shown in the engraving consists of two principal parts, the cylinder and the frame, which is a tapering column having openings in the sides, to allow free access to all the working parts within. The slides and pillow-blocks are cast with the column, so that they cannot become loose or out of line; the rubbing surfaces are large and easily lubricated. Owing to the vertical position, there is no tendency to side wear of cylinder or piston. The packing-rings are self-adjusting; the crank is counterbalanced; the crank-pin, cross-head pin, piston-rod, valve-stem, etc., are made of steel; all the bearing-surfaces are made large, and accurately fitted; and the best quality of babbitt metal only should be used for the journal bearings.

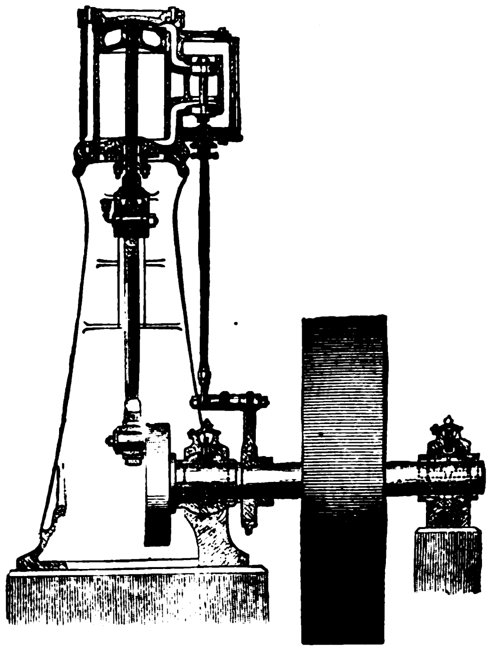

FIG. 31.—VERTICAL STATIONARY ENGINE. (Scale 1-16.)

The smaller sizes of these engines, from 2 to 10 horse-power, usually have both pillow-blocks cast in the frame, giving a bearing each side of the double cranks. They are built by some constructors in quantities, and parts duplicated by special machinery, which secures great accuracy and uniformity of workmanship, and allows of any part being quickly and cheaply replaced, when worn or broken by accident. The next figure is a vertical section through the same engine.

Engines fitted with the ordinary rigid bearings require to be erected on a firm foundation, and to be kept in perfect line. If, by the settling of the foundation, or from any other cause, they get out of line, heating, cutting and thumping result. To obviate this, modern engines are often fitted with self-adjusting bearings throughout; this gives the engine great flexibility and freedom from friction. The preceeding figure shows clearly how this is accomplished. The pillow-block has a spherical shell turned and fitted into the spherically-bored pillow block, thus allowing a slight angular motion in any direction. The connecting-rod is forged in a single piece, without straps, gibs, or key, and is mortised through at each end for the reception of the brass boxes, which are curved on their backs, and fit the cheek-pieces, between which they can turn to adjust themselves to the pins, in the plane of the axis of the rod. The adjustment for wear is made by wedge-blocks and set-screws, as shown, and they are so constructed that the parts cannot get loose and cause a break-down. The cross-head has adjustable gibs on each side, turned to fit the slides, which are cast solidly in the frame, and bored out exactly in the line with the cylinder. This permits it freely to turn on its axis, and, in connection with the adjustable boxes in the connecting-rod, allows a perfect self-adjustment to the line of the crank-pin. The out-board bearing may be moved an inch or more out of position in any direction, without detriment to the running of the engine, all bearings accommodating themselves perfectly to whatever position the shaft may assume.

The ports and valve passages are proportioned as in locomotive practice. The valve-seat is in this instance adapted to the ordinary plane slide or D-valve, should it be preferred; but the balanced-piston slide-valve works with equal ease, and at the same time gives double steam and exhaust openings, which greatly facilitates the entrance of the steam to, and its escape from, the cylinder. The vertical direct-acting engine is sometimes, though rarely, built of very considerable size; these large engines are more frequently seen in rolling-mills than elsewhere.—[From "A Manual of the Steam-Engine," by Prof. R. H. Thurston; John Wiley & Sons, 53 E. 10th St., New York.

(To be continued.)

Chautauqua Lake

Is acknowledged by all to be one of the most delightful places where the warm summer months can be spent, and the Nickel Plate is affording its patrons every opportunity which can be desired for visiting this charming resort. They have instructed their Agents to sell excursion tickets at special reduced rates.

STEAM PUMPS.—V.

BY J. C. SMITH, M. E.

Those duplex pumps already described are operated by valves moved mechanically; but there are duplex pumps on the market, whose valves are moved by the action of the live steam itself.

The valve chests are fitted with auxiliary pistons attached to the main valves; and the admission of steam used to drive these auxiliary pistons is governed by the main piston of the opposite steam cylinder.

Communication is made between the valve chest on one side, and to the steam cylinder on the other side, in such a way as to admit live steam from the steam cylinder to the valve chest, throwing the auxiliary valve in the valve chest, and permitting the live steam to act on one end of the auxiliary piston, while the steam is exhausted from the other end, thus moving the auxiliary piston together with the main valve which admits steam against the face of the steam piston of its corresponding cylinder and moving it in the opposite direction in its stroke.

When this steam piston has reached a certain point of its stroke, steam is admitted from this steam cylinder into its opposite valve chest, moving the auxiliary valve and admitting steam against the auxiliary piston, moving it, together with the main valve, when the steam pressure moves the second steam piston in the opposite direction, precisely as was done in the first cylinder.

When the pump refuses to work, the operator is often at a loss to know what to do, as he sees nothing which can be repaired or adjusted; and time is often needlessly sacrificed in overhauling the auxiliary valves and pistons.

The principal difficulty in pumps of this kind lies in the fact that the many small steam passages, necessary for the working of the pump, become clogged with dirt, thus choking the supply of steam and, therefore, stopping the pump.

By taking off the valve chests and removing the plate between the valve chest and steam cylinders, taking care to mark the various pieces so they may be replaced properly, these little channels may be cleaned out; and, when the different parts are properly put together, the pump will start off in good working order.

Direct-acting pumping machinery as a rule is required to stand much more abuse, and more is required of it than any other class of machinery; and, from its simplicity of construction, it is able to stand it; but there is no service more exacting than that for fire protection. A pump used for this purpose is supposed to start off at any moment, no matter how long it has been in disuse; and, as it is liable to be brought into service at any time, it is required to move with a low pressure of steam, as it may be needed at night when the steam pressure is low.

The various insurance companies, recognizing these trying conditions, and finding but few pumps capable of fulfilling them, have in conjunction with some of the leading pump makers, produced a set of specifications which would seem to be the ideal engine. As these specifications would require considerable space, and as their perusal would interest those only who are concerned in the design, they will be omitted in this article, informing those who desire them that by application to any of the insurance companies a copy can be obtained.

Before leaving the subject of duplex pumping machinery, it might be advisable to give a few rules and examples for computing the relative proportions of piston areas and pressures under different conditions, which are as follows:

1. To find the relative proportion between the steam and pump cylinder:

Multiply the given area of the pump cylinder by the resistance on the pump in pounds per square inch, and divide the product by the pressure of steam in pounds per square inch; the quotient equals the area of the cylinder in square inches to overcome the load; to this must be added an extra area of 25 per cent. to overcome the friction.

Example:

Diameter of pump cylinder, 7″, pressure against pump piston, 60 pounds, steam pressure, 70 pounds, to find diameter of steam cylinder; area of 7″ piston equals 38.48 square inches, hence, 38.48 × 60 = 2,308.8 pounds total pressure, 2,308.8 ÷ 70 = 32.9 square inches to balance the load. 25 per cent. or ¼ of 32.9 square inches equals 8.2 square inches, which added to 32.9 = 41.1 square inches, which is equal to 7¼″, the diameter of piston, the size of steam piston required.

2. To find the pressure against which a pump can deliver water, when the diameter of the steam cylinder, the steam pressure and diameter of pump barrel are given:

Multiply the area of the steam cylinder by the pressure of steam in pounds per square inch, and divide the product by the area of the pump piston; this quotient minus 20 per cent., or 1·5, will be the pressure per square inch against which the pump will force the liquid.

Example:

A pump, the steam cylinder of which is 7¼″ in diameter, the water piston 7″ in diameter, and the steam pressure 70 pounds per square inch; area of 7¼″ steam piston equals 41.2 square inches, hence, 41.2 × 70 = 2,884 pounds, total of steam pressure; Area of 7″ water piston equals 38.48 square inches; then 2,884 ÷ 38.48 = 74.98, from which subtracting 1-5 or 20 per cent. leaves 60.9 pounds, the pressure against which the pump will force the liquid.

3. To find the steam pressure required, when the diameter of the steam cylinder, the diameter of the pump barrel and the resistance against the pump in pounds per square inch are given:

Multiply the area of the pump piston in square inches, by the resistance on the pump in pounds per square inch, and divide the product by the area of the steam cylinder; this quotient, or answer, equals the number of pounds of steam pressure per square inch necessary to balance the load; to this must be added 25 per cent. or ¼ to overcome the friction.

Example:

Diameter of steam cylinder equals 7¼″, diameter of pump piston, 7″, pressure against the pump 60 pounds per square inch, to find the steam pressure; 7″ diameter equals 38.48 square inches, therefore, 38.48 × 60 = 2,308.8 pounds total pressure; 7¼″ diameter of piston equals 41.2 square inches; therefore, 2,308.8 ÷ 41.2 = 56 pounds per square inch to balance water piston. 25 per cent. or ¼ of 56 = 14 pounds, hence, 56 + 14 = 70 pounds pressure per square inch to drive the pump.

4. To find the diameter of pump piston, when diameter of steam cylinder, steam pressure in pounds per square inch and the resistance against the pump piston in pounds per square inch are given:

Multiply the area of the steam cylinder by the steam pressure in pounds per square inch, and divide the product by the resistance on the pump in pounds per square inch; from this quotient subtract 1-5, or 20 per cent.; the remainder will be the area of the pump piston.

Example:

Diameter of the steam cylinder equals 7¼″, steam pressure equals 70 pounds per square inch; pressure on pump equals 60 pounds per square inch. 7¼″ piston equals 41.2 square inches, then 41.2 × 70 = 2,884 pounds, which is the total pressure on the steam piston; 2,884 ÷ 60 = 48 square inches, 1-5, or 26 per cent. of 48 = 9.6, which substracted from 48 leaves 38.4 square inches, which is the required area of the water piston whose diameter is 7″.

To save the time in computing the areas of circles, reference can be had to the tables on areas of circles, which can be found in any catalogue on pumping machinery, or in any of the engineers' reference books.

When the pressure is given by the height of the discharge column, instead of in pounds per square inch, it can be converted into the latter by the method explained in a previous article.

Sometimes the horse-power of a pump is required, although the economy of a pump is rated in duty, as will be explained hereafter. To find the horse-power of a pnmp, all that is necessary to do is to get the weight of the water discharged in a certain length of time, say an hour, then multiply this weight by the height to which the water is lifted, and divide the product by 33,000 × 60 = 1,980,000, which is the number of foot pounds lifted in one hour; this quotient obtained will be the horse-power.

Example:

Let it be required to find the horse-power of a pump moving 3,000,000 gallons of water in 24 hours against a pressure of 80 pounds to the square inch. 3.000,000 ÷ 24 = 125,000 gallons, which is the quantity of water delivered in one hour; and since a gallon of water weighs 8⅓ pounds, 125,000 gallons will weigh 125,000 × 8⅓ = 1,041,666 pounds, the weight of water delivered in one hour.

Since the pressure against which it is delivered is 80 pounds, and, since a column of water one square inch in cross section weighing one pound is about 2¼ feet high, a column of water one square inch in cross section and weighing 80 pounds would be 80 × 2¼ = 180 feet, therefore, the pump performs 1,041,666 × 180 = 187,499,880 foot pounds per hour; dividing we have 187,499,880 ÷ 1,980,000 = 94.6 horse-power, which is the force exerted by the pump in horse-power. To this should be added the force necessary to overcome the friction of the water in the delivery pipe and which depends upon its diameter.

A PROBABLE CAUSE OF BOILER EXPLOSIONS*.

BY CHAS. PIERCE.

For ages past, in fact, ever since steam has heen commonly employed as a source of power, a boiler, here and there, has exploded and under such circumstances and conditions as has left the actual cause of the disaster shrouded in mystery. Whenever, or wherever one of these unfortunate occurrences take place, a variety of opinions are advanced as to the true cause. From those who are but little informed on the subject of steam and its practical application we almost invariably hear the cry "low water" and reflections cast upon the competency or attentiveness of the engineer, while at the same time it may be positively asserted by the engineer and fireman, those best qualified to know, that the boiler contained the usual amount of water.

Wherever low water is in any way responsible for the explosion of a boiler it may safely be considered that by the water being low the iron in tubes or crown sheet had become overheated, probably to such an extent that the pressure of steam forced the iron until it was drawn thin and eventually ruptured, or that after having been heated to a high temperature, it was cooled by the influx of water and the rapid contraction caused the plates to crack, thus giving the steam a start, and the further opening of the rupture produced the fearful consequences which usually follow such an occurrence.

Various other causes have been advanced for the explosion of boilers and in many cases it has been proven by investigations and tests that the boiler was not of sufficient strength to carry the pressure safely and allow any margin. Corrosion, crystalization, deterioration and strains set up in the plates or stays at the time the boiler was built, or afterward, have so reduced the factor of safety in the actual strength of the structure that had such facts been known before the explosion occurred, the accident would have caused no surprise.

Many of these deteriorating effects take place in such an insiduous manner that without a full knowledge of the characteristic effects, it is difficult to detect the exact locality, or in fact, the existence of such event. The overstrain of a plate from any cause, although it may be nearly to the elastic limit, gives no outward indication of its existence, and is most difficult of detection. Crystalization, another dangerous and insiduous feature, causes no change in outward appearance of the metal, but may be detected by the proper tests.

These are but a few of the occurrences which may take place and that we know will greatly weaken the strength of a boiler. They are merely mentioned, incidentally, as among the possible causes which weaken the boiler plate until it can no longer withstand the strain forced upon it and it finally gives way, many times with fatal results, and always leaving wreck and ruin behind. But there are other causes which might be plausibly advanced to account for the sudden rupturing of a well made boiler of ample strength for ordinary conditions and that some of these have at times been the real cause of a boiler explosion has been sufficiently well proven to require them to be accepted as possible causes of such disaster.

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*Read before Chicago Association No. 28, N. A. S. E. August 20, 1892.

From observations during 19 years experience as an engineer in running boats in and out of the small harbors on the east shore of Lake Michigan, my conclusions lead me to believe that the manner in which some boilers are handled is more productive of boiler explosions than the way they are handled in the larger harbors, like Chicago, for instance. In the large harbors, when an engineer receives an order to go, the boat goes at once and is not called back to the dock for some time, possibly until hours afterward; but in the small harbors it frequently happens that just after the boat has left the dock it is called back again and may lie there for an hour or even more. This practice has a bad effect on the boiler for, it being expected that the boat would go as arranged, the fires have been prepared accordingly, to make the required steam and on being called back to the dock, they go right on steaming, compelling the engineer to either run his engine while lying at the dock, lift the safety valve, or pump in water and blow it off. Both owners and captain object to the first method on account of the wear and tear on the lines, and the last method is objectionable on account of the waste of fuel and requiring a surplus of water in the boiler. This leaves him with only his safety valve with which to dispose of the surplus steam and often he dislikes to use this on account of the uncertainty of when an order to go may be received.

In theory, the boiler is supposed to have a safety valve large enough to reduce the pressure at once, but I have often noticed that it would be some little time after the valve had been raised before the gauge would indicate a reduced pressure and it would some times appear as though the pressure increased, even with the valve raised and steam blowing off freely.

Conditions of this kind will, of course, increase the liability of explosion and we believe that some times when the throttle is closed, the circulation in the boiler stops and the heat from the fires continues passing into the water, so that when the throttle is again opened, this stored heat may instantly convert a large portion of the water into steam, which will cause a pressure greater than the boiler can stand and, consequently, an explosion results. That this condition often occurs in a boiler has been shown by numerous tests, and many explosions have been attributed to such cause.

The theory used to explain such condititions is that the water, naturally containing some air, as has been frequently and conclusively demonstrated it boils at a certain degree of temperature, but after the air has been boiled out of the water and passes off with the steam, which it will readily do, because only a small quantity of heat is required to free the air from combination, the water then becomes more dense and if kept quiet, as it probably would be by the superimposed pressure, a surplus of heat units is transmitted to the water and remain inactive so long as the water is quiet, but immediately this condition being changed and the water put in circulation, as it would be by the sudden opening of the throttle or safety valve, the heat then transforms a large portion of the water into steam and the instantaneous change produced, exerts an increased pressure which comes with a hammer like blow and the result frequently is that the boiler gives way.

One peculiar circumstance that would seem to bear out this theory, was the explosion of a locomotive boiler on a Texas railway, where the train had been run on to a siding with the expectation of its laying there upwards of half an hour, and although the usual pressure of steam carried was 140 pounds, it was allowed to fall to 85 and the boiler was filled with water—four gauges solid. The train crew, including engineer and fireman, went into an eating house at the station for breakfast and the engineer, so soon as he had finished, returned to the engine and while standing on the ground, looked at the steam gauge and seeing but 80 pounds of steam, thought he would look at the fire. As he jumped on to the step of the engine, the boiler exploded, giving way at the sheet directly in front of the firebox, on the under side of the shell. The explosion completely wrecked the boiler and the engineer was so badly scalded that, although he lived through it, he is terribly scarred. The cause of this explosion was explained as having been due to the heat absorbed by the water, which did not transform it into steam until the water was agitated or put into circulation.

As engineers, it stands us in hand to carefully study all of the theories advanced in explanation of the cause of boiler explosions for, it must be admitted, that we are deeply interested in the safety of the boiler, and if the theories advanced do not agree with the views we hold at the time, it will do no harm for us to investigate them carefully and by so doing, it is possible that some facts will be brought to our notice with which we had not previously been familiar.

Burlington Route New Service.

A through Pullman sleeping car Chicago to San Francisco is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11:45 A. M., less than four days en route.

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RAILROAD MOTIVE POWER—I.

In view of the present general depression in railroad business and the strenuous efforts put forth to curtail and economize, in order to tide over to more prosperous times, it may not be amiss to make some extended remarks relative to the management of the machinery department.

No one unconnected with the mechanical department of a railroad can form any correct idea of the ease with which money may be squandered in an indifferently managed railroad shop. Aside from the fact that the modern locomotive, *per se*, is an unnecessarily expensive machine to keep in repair, there are other items of useless expenditure that should be taken cognizance of. I shall endeavor, in what follows, to show wherein the locomotive may be advantageously improved, and at the same time allude to some shop abuses in a general way.

It seems to me very strange that, considering the rapid strides made in mechanical engineering during the past quarter of a century, nothing has been invented to take the place of that expensive and unsuitable locomotive appendage, commonly called a link. Almost every other part of the engine, from the pilot to the tail piece, has been changed or modified to some extent, but the link like the Chinese, is still with us.

Now, what is this link, that has developed such remarkable staying qualities, good for? The answer would be, that so far as the locomotive is concerned, it is good for nothing except to reverse the motion of the engine. And yet master mechanics cling to the link with a tenacity that is really surprising, for the simple reason I suppose, that they have nothing better to substitute. But, why should they remain in this dilemma? Injectors have superceded pumps. Steam fountains obviate the necessity for a half dozen or more ugly holes in the back head of boiler. Fire-boxes have been perforated in front and sides with air holes and ornamented with garlands of steam jets, in order to create more perfect combustion. Water tables and brick arches have been tried for the same purpose, regardless of expense. The extended smoke box has been petted and pampered in order that a few sparks might be arrested on their outward journey. Patent bell ringers, automatic cylinder oilers, driver brakes, steam reversers, mudpots, and a multitude of other contrivances, good, bad and indifferent have been tried and experimented upon at an enormous expenditure of both time and money, but nothing, practically, has been done to relieve the locomotive of that crowning incubus and ancient mechanical abortion, the link.

It is true an attempt has been made to displace the link by substituting the Stevens valve motion, but the latter being somewhat cumbersome as well as complicated, and withal, quite expensive, it is a question whether the cure is not as bad as the disease.

The waste of steam caused by the link, when reduced to dollars and cents is something astounding. It may be safely assumed that the average waste of steam will reach fully 45 per cent. of that flowing into the cylinders of a freight engine, and will reach a higher percentage when cutting off very short.

That the link must go, there can be no question, but what to substitute therefor is an intricate problem, to the solution of which it behooves master-mechanics to bend all their mechanical energies. It would seem that with the adoption of a perfectly balanced main valve of few parts, cheaply constructed, yet, withal, equally as durable and as tight as the common D valve after being freshly faced to its seat, the radical change must take place in the main axle. The eccentric and strap now in use must be thrown aside, and a duplex action eccentric, with but one rod for both the forward and the backward motions, substituted; at the same time having in view a constant outside valve lead for all points of cut-off.

As the tendency is toward longer fire-boxes in order to get increased grate area, it might be necessary to move the main driving axle a little forward to accommodate the new appliance. With engines having the extended smoke box, the cylinders could be set sufficiently forward to avoid any shortening of the main rods; on the other hand, engines not so equipped could have their smoke boxes lengthened sufficiently to bring about the desired results.

With regard to valve lead, why there should be such diversity of opinion among master-mechanics regarding the proper quantity of outside valve lead, I cannot understand. If one-sixteenth of an inch is deemed sufficient lead for the valves of one engine, why should not the same amount be the correct thing for the valves of another engine of same cylinder and port dimensions, and working under precisely the same conditions of load, track, fuel, steaming qualities, etc? Yet, we find in practice that the variation ranges from one thirty-second to three-sixteenth of an inch. With the use of the link there is too much back pressure on the piston, caused by too early closing of the exhaust, excessive lead tending to augment compression, without any corresponding beneficial result observable anywhere. With the link it would seem that lead might be very properly dispensed with, as the compressed steam before the piston affords all the cushion necessary.

Although there are a score or more balanced slide valves on the market, scarcely any are used on locomotives. This may seem strange to some, and might imply prejudice on the part [illegible]aster-mechanics. Such prejudice does not, however, exist, as a general thing; although there are some men who habitually turn up their noses and sneer at any innovations, so far as improving their engines is concerned. But, happily, this class is in the minority among master-mechanics. The true reason is, I believe, that balanced valves have been found woefully wanting, as the great majority of them are fit only for the scrap heap. Others again, that have any shade of merit are so fearfully and wonderfully made that the master-mechanic can see at a glance their utter worthlessness so far as a locomotive is concerned.

D.

(To be continued.)

Reduced Rates.

To the West via the Nickel Plate.

THE VALVES AND VALVE MECHANISM OF THE PORTER-ALLEN STEAM ENGINE*.

F. G. GASCHE.

Mr. Chairman and Gentlemen of the N. A. S. E:—During the past week one of your associates, Mr. O'Brien, informed the speaker that according to the representations of a number of your members, a few remarks upon the valve gear and valves of the Porter-Allen engine would be acceptable this evening. The manner in which the invitation has been proffered, will, it is hoped, exempt the speaker from all accusations of partiality in reviewing the distinguishing features of but one type of engine. The subject is worthy of a more thorough consideration than the limited time will permit or that the patience of the auditors could endure in view of the fact that many engineers already possess an intimate knowledge of this type of valve.

Properly, the analysis of the valves and valve mechanism of the Porter-Allen engine is preceded by the inquiry as to characteristics of a perfect steam valve, also what would be the nature of the results that could be obtained from such a v[illegible] Were the construction of a perfect valve a possibility, the various phases of its motion could be completely and accurately determined from the theoretical indicator card. The characteristics of this valve could also be predicted when the knowledge imparted by this analysis is combined with known physical laws.

This being a meeting of engineers a repetition of what has been said before in regard to the meaning of the several parts of an indicator card will be considered superficial, an acquaintance with the instrument by which they are obtained is also presumed, so that we may proceed at once to the study of the theoretical indicator card or the one which the perfect valve would produce. This card is the same that would be obtained from the ideal engine, by means of which the highest possible percentage of available heat energy is converted into work. The theoretical indicator card has never been produced at any other place than the engineer's drawing board. Some types of valves permit a very near approach to this card, but so long as the designer is encumbered by inertia of reciprocating parts, by friction of metallic surfaces and of steam in passages, just so long will the advent of the perfect steam valve be deferred.

The various parts of the theoretical indicator card may thus be defined. Referring to Fig. 1. Steam having been trapped in the cylinder by a proper action of the valve or valves while the piston is in motion, a continuation of that motion compresses the enclosed steam to some pressure represented by the point *a*. This pressure depends upon the volume of the clearance or dead space, the distance from the end of the stroke at which the compression commences, and the pressure of the steam within the cylinder at the time of the latter event. The introduction of this compression curve presupposes the existence of clearance either intentionally or unavoidably.

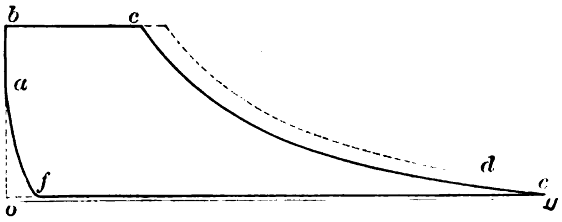

FIG. 1.

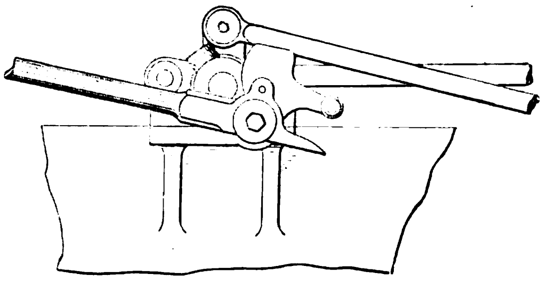

FIG. 3.

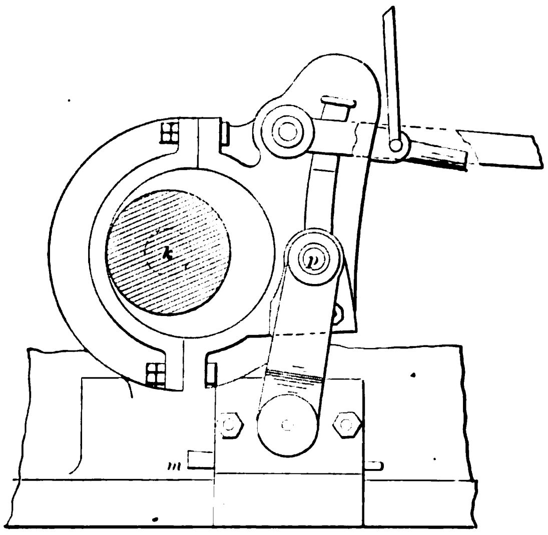

FIG. 2.

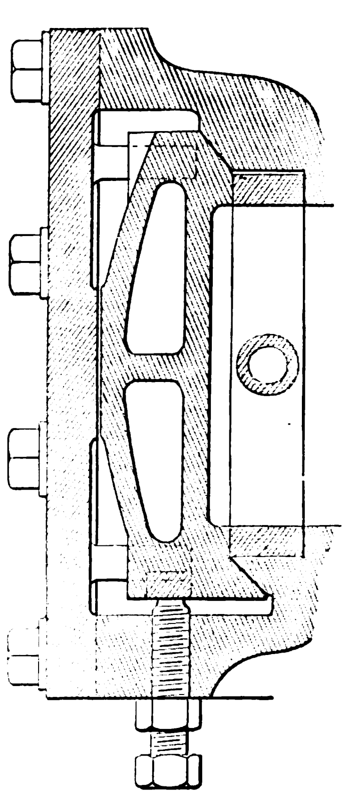

FIG. 7.

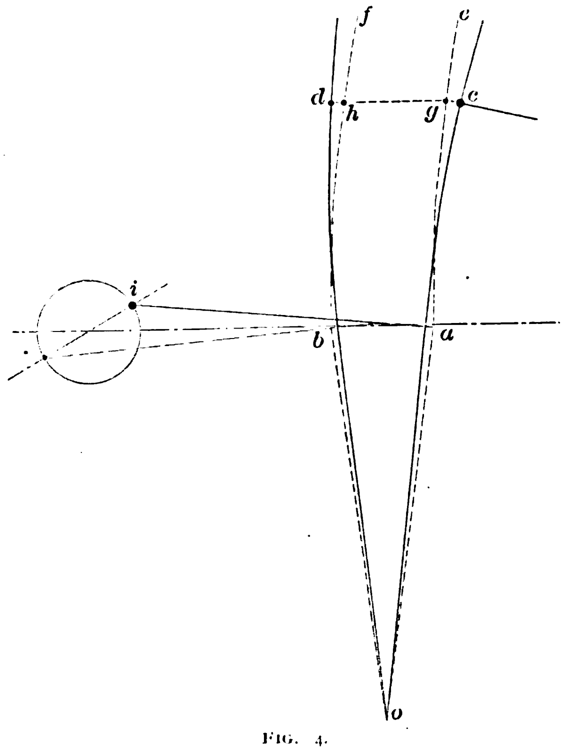

FIG. 4.

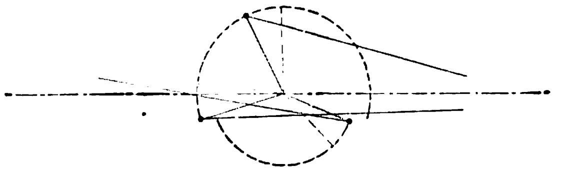

FIG. 5.

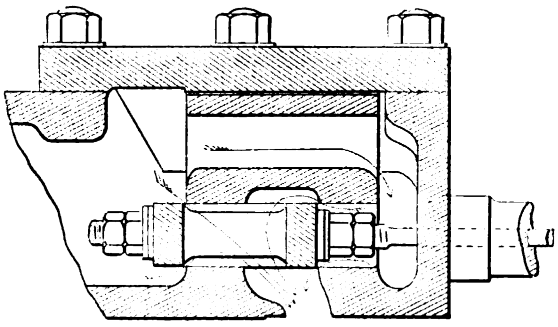

FIG. 6.

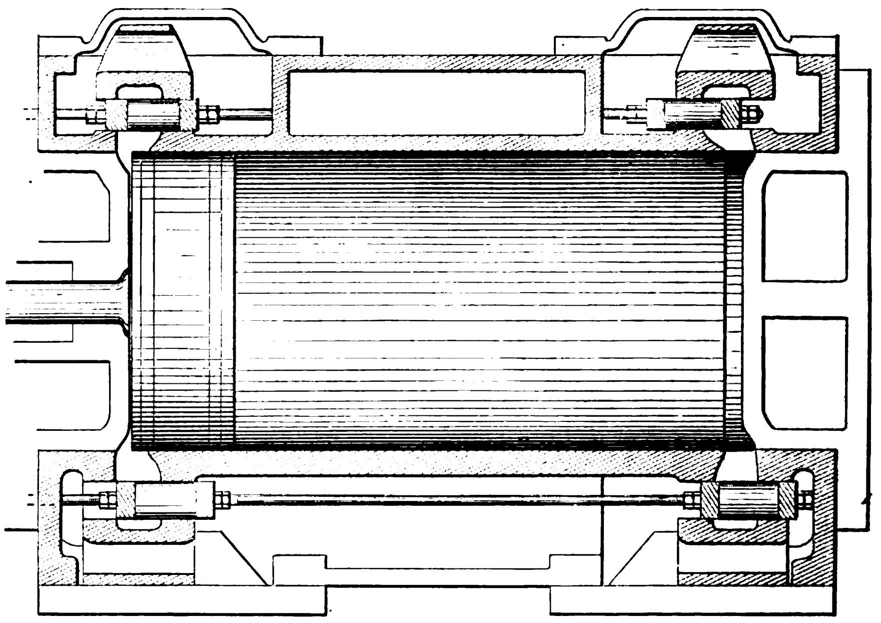

FIG. 8.

VALVES AND VALVE MECHANISM OF THE PORTER-ALLEN ENGINE.

It may be explained that the ideal steam engine, *i. e.*, one in which the attainment of the maximum thermodynamic efficiency is sought, without regard to the manner in which forces are transmitted, which practical considerations would impose, *no clearance would exist.* At the same time compression would be avoided and the curve *a f* would reduce to a form making a right angle *b o e*.

Steam having been compressed to *a*, live steam is admitted in such a manner as to occasion an instantaneous rise to the full boiler pressure *b* and the piston proceeds on its stroke. Up to the point of cut-off *c*, the pressure of the steam in the cylinder is maintained exactly equal to the boiler pressure.

At *c* the steam is instantly and completely cut off from the boiler communication, and, the motion of the piston proceeding, the steam expands to a point *e* by certain approximately determined laws depending on its condition during expansion, whether it is superheated, dry and saturated, or moist. In the ideal engine the point *e* is but an infinitesimal distance above the line of external pressure *o g*. So, also, is the back pressure line *e f* passing through *e*.

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*A paper read before Illinois No. 29 N. A. S. E. of S. Chicago, Saturday, July 30, 1892.

From the preceding statements the qualifications of the ideally perfect valve or valves may be predicted.

I. A sufficiently prompt and full opening of the valve at the commencement of the stroke of the piston, to permit of an initial pressure equal to boiler pressure.

II. During the motion of the piston and up to point of cut off the valve must present such a free and ample opening for steam that the pressure of the steam in the cylinder is maintained exactly equal to boiler pressure.

III. Cut-off at all piston speeds should be instantaneous and so complete that all flow of steam from the boiler to the cylinder or from the cylinder to the exhaust is prevented, after this event occurs.

IV. Release of the steam, like the cut-off should be instantaneous, after which event the exhaust opening, up to the time when compression commences, is sufficient to prevent any increase in the back pressure above the external pressure, by frictional resistance to the steam.

V. Exhaust closure should also be as instantaneous and complete as the cut-off, since any resistance to the flow of steam into the exhaust during the portion of the stroke between *e* and *f* (Fig. 1) is entirely prejudicial for none of this work can be reclaimed as stored energy during the succeeding, and any leakage of steam during the remainder of the stroke while compression occurs from *f* to *a* is likewise entirely prejudicial in its effects.

In addition to the above, as conditions to be approximated by a valve system of good design, it should possess as far as possible the following characteristics:

First. A construction permitting of independent control of admission with cut-off and release and exhaust with compression. Without challenging the claims of those who advocate a variation in the amount of compression with every change of load.

Second. The valves should be as nearly frictionless as possible, not only to preserve the accuracy of their defining surfaces but also to enable them to operate with precision. This is generally accomplished by either of the following methods: By reducing the area of the face of the valve exposed to full pressure as in the Corliss engine; by reducing the travel of the valve, and obtaining the necessary openings by the use of multiple ports; or by employing a larger working surface and relieving the steam pressure on the valve, or "balancing" it by the use of a "pressure plate," as in the Straight Line, Porter-Allen, and other engines. The same construction usually permits the use of a "multiple ported" valve.

Third. The speed of closing as well as of opening of the valve or valves should vary directly with the speed of the engine. Otherwise a considerable distortion of the indicator cards will occur at the higher piston speed, meaning of course a less economical use of steam.

Fourth. The valve giving the best steam distribution, while supplying ample port opening, will be small and light, so that in rapid motion of the engine and valves the effect of inertia will be a mimimum. The same might be said of mechanism by means of which motion is communicated to the valve.

How the valves and valve gear of the Porter-Allen engine will fulfill these requirements may be inferred from the crayon sketch before you. Fig. 8 represents a horizontal section through the center of the cylinder, valves, and pressure plates of this engine. Fig. 6 represents the valve and pressure plate in detail, while Fig. 7 is a vertical section through the center of the same. Fig. 2 is a side view of the Allen link and valve mechanism. Fig. 3 is a side view of the differential rocker arms securing their motion from a rod, the opposite end of which is fastened to the block that moves freely in the slot of the link. Fig. 4 is a skeleton diagram of Fig. 2, so also is Fig. 5 such a diagram of Fig. 3.

Referring to Fig. 7 it is seen that a balanced valve is used, the pressure upon the same being relieved by a pressure plate of peculiar construction between which and the seat the valve moves freely and with little friction. The support of the pressure plate consists of two beveled faces in parallel planes resting on corresponding beveled faces above and below the port in the cylinder. By means of this pair of beveled faces any vertical motion of the pressure plate is necessarily accompanied by a horizontal component, when steam pressure keeps the plate in position. The exact position of the pressure plate with reference to the valve seat, is consequently determined with the greatest precision by the adjusting screw passing through the lower portion of the steam chest upon which the pressure plate rests.

Referring to Fig. 6 it is seen that the pressure plate combined with a valve seat of the same face dimensions, permits of the use of a four ported valve, thus making the effective opening for the passage of steam, just four times the motion of the valve during the period when the port is opened.

Fig. 2 and Fig. 4 show that the motion of any point on the center line of the link slot is combination of two motions, a horizontal translation, or rather a rotation about the center *o* through a small angle and a rotation about the center *p*. The ideal motion of *p* would be a simple translation along the horizontal line through the center of the crank shaft, a motion along straight guides or other constraining device. For convenience a rocker arm *o a* rotating about *o* is used.

In the best construction or adjustment of this device the length of *o a* is so selected that the point *a* vibrates an equal distance on each side of the horizontal line before mentioned. This would give an absolute equality of the motions of the valves at each end of the cylinder, but owing to the difference in the piston velocity near the ends of the cylinder, it is desirable to increase to a proportionate amount both the lead and the cut-off for the head end valve, and this is accomplished by lowering either *o* or *a* so that the arc in which *a* vibrates is tangent to the above horizontal line.

The center of the eccentric, the center of the crank pin and the center of the shaft are all in the same radial line, and it is seen by the Fig. 4 that as a consequence of this relative position of centers, there are two positions of the center line of the link *b o* and *a g*, corresponding to the ends of the piston stroke where these lines are parallel. Their distance apart is of course equal to the throw of the eccentric.

Let *a i* represent the line joining the front *a* and the center of the eccentric *i*. The relation of the lengths *a i* and the radius of the eccentric is made the same as the ratio of the lengths of the connecting rod and the crank of the engine. By this construction the velocity of the valves is made exactly proportional to the piston speed near the respective ends of the cylinder.

The lines *a i* and *b h* move together as a bell crank tripping the latter outside of the "lead lines" near the end of the stroke. This slight tipping, due to a rotation about *a* is the motion that opens the steam valves and it will be observed, always occurs in a direction opposite to the motion of the piston. Whenever the center of the link block crosses the imaginary head line, the port is closed.

Let *d h g e* represent the path of the center of the link block, then the valve action would be as follows: opens from *g* to *c*, closes from *c* to *g*, continues to *h*, opens at the other end of the cylinder from *h* to *d*, closes from *d* to *h* and moves to *g* where the revolution is completed.

The connection to the exhaust valves is made to the pin on the side of the link and of course gives them a fixed throw. Like the steam valves, their velocity is directly proportional to the piston speed in their vicinity, a feature that is especially desirable in a high speed engine.

A modification of the Corliss wrist plate is seen in the differential motion, Fig. 3, whereby the steam valves are permitted to remain with but little motion up to the time when rapid action is desirable.

The equalization of the lead and the cut off, especially the latter, is effected to a degree that is almost objectionable by the relative position of the crank shaft and the center *a* of Fig. 4 with reference to the horizontal line through the center of the shaft. If, through wear or incorrect adjustment *a* is lower than the center of the shaft the effect would be to increase both of the above events at the head end of the cylinder, and to decrease them by the same amount on the crank end of the cylinder. As before explained this is to a certain extent desirable and the adjustment is intentionally made to accomplish these results. Evidently a wear or displacement in the opposite direction of these centers would be accompanied by a corresponding derangement of the valve action to the opposite end of the cylinder.

A word may be added in regard to the care of the pressure plates and valves. This construction possesses advantages which will enable the engineer to realize the most satisfactory results in the way of the economical use of steam, if it is kept in good condition; but if neglected it is likely to produce more friction around a plant, other than that of metallic surfaces, than anything for which the engineer is responsible.

If, while the steam is turned on and the indicator plugs are removed from the cylinder, the engineer moves the steam valve, with the starting bar provided with each engine, any leakage of steam between one of the steam valves and its pressure plate will be apparent at the indicator cock provided that the exhaust valve covers the port at the corresponding end of the cylinder. An assistant can now adjust the pressure plate by means of the screw beneath until in the judgment of the engineer all the leakage is stopped that easy working of the valves and the condition of the working surface will permit.—[The Stationary Engineer.

An American Automatic Tinning Machine.

Mr. J. B. Myers, who is connected with a firm of tin plate manufacturers, of Philadelphia, in a recent interview said:

"We have in use an automatic tinning machine, of American manufacture, which enables us to turn out roofing plate 50 per cent. superior in quality to any ever manufactured in England or Wales. Our iron is manufactured by the Apollo Iron Co. This iron, which is in sheets, is fed into the machine. It is carried into a box containing two rotary brushes, which scour off all the scales and other impurities on both sides. The sheet next passes into a spraying box, where all adhering particles are washed off. It is then thoroughly dried by passing through a set of rolls. The next set of feed rolls carry the plate to the edger, a device for edging the separate sheets, and passing them on together in a continuous strip. After the continuous sheet passes through the flux pot it runs into the tinning pot. Rising out of the pot the sheet passes through palm oil. It is then carried upstairs by the machine, cut into strips of any desirable length, and stored in rolls. The tin coating is well and evenly applied and the joint between the sheets is thoroughly soldered. Although the machine is now used in making terne plate it can be used equally well on bright plates, either in continuous strips or separate sheets. The average capacity of the machine is equivalent to one hundred boxes of 20x28 sheets per day of ten hours. It enables us to turn out a better quality of tin than is made in Europe. Under the plan used in Europe the iron plates are first pickled in acid in order to remove the impurities. The machine obviates this. Then again the plates are more evenly tinned here. In Europe the plates are dipped, and the coat is uneven, being much heavier at the bottom than at the top. Experts say that under the plan in vogue in England and Wales, it is impossible to put more than 40 pounds of tin in a box of plates 20x28 inches. Under our process we can put in any amount of tin, up to 100 pounds, if necessary."

In reply to a question whether the manufacture of tin plate in this country affected the importation from abroad, he replied that it had materially reduced imports.

Rare Opportunities.

The Queen & Crescent Route will place Excursion Tickets on sale to Texas and Arkansas, also Indian Territory, at greatly reduced rates, on August 30, September 27th, and October 25th. Good for return 20 days from date of sale. For rates, maps and further information, call on Agents of the Q. & C. Route, or agent at your station, or address D. G. Edwards, G. P. A., Cincinnati, O.

Practical Letters.

A Different View.

EDITOR SCIENTIFIC MACHINIST:

In your answer to question 409, in Aug. 1 issue, I beg leave to differ with you. You state that the pressure of water is due only to the height of the column of water directly above each particular square inch, which is not correct, as the pressure per square inch depends wholly on the depth below the surface no matter what shape or size the vessel may be. For instance, if you take a perpendicular pipe of any height and fill it with water and attach a steam gauge at the bottom with a straight pipe (the gauge then being bottom side up) it will register the same pressure as it would if an elbow had been used and the perpendicular height of the water above the gauge reduced to one-half the diameter of the pipe, the height of the two surfaces of water in each case to be the same distance above the center of the gauge. WALTER SCOTT.

[This case is not parallel to the one the answer to which is cited by Mr. Scott.—ED.]

Frank Wilcox to "A. D. J."

EDITOR SCIENTIFIC MACHINIST:

In answer to the question asked me by Mr. A. D. Joels in your last issue, will say Mr. J. seems to take the wrong meaning of this matter. Now, you will remember that I wrote you that there was in my opinion some wild calculating on the setting of Mr. J.'s boilers or some misunderstanding. Now, it is quite clear there was a great misunderstanding, and will say if the two boilers were set as was supposed at first, that is, with connections above and below, then I maintain just what I said, that the water passed from the large boiler to the smaller for the simple reason that water will run down hill. But Mr. J. now explains the boiler question more clearly and says the boilers are not connected together at the bottom, but only by a cross steam pipe on top, and he says he has stopped the water from running from the large boiler to the small and asks me how it was done. And in answer will say I hardly believe he did it by raising the engine up as he first mentioned. If the small boiler is, as I think, between the large one and the engine, I would then have the steam pipe as it runs from the large boiler to the engine, with end that connects on the boiler lower than the other end. Then I should put a T in the steam pipe over the small boiler so that the steam from the small boiler would enter the steam pipe on the top side instead of the under side, as is usually done. However, these boilers are exceptionally set and in order to fully understand the exact condition, should be seen.

Mr. J. asks me how I should set the valves. He says there are two valves. I would ask, does the one valve or both act as cut-off on live steam? If I understand Mr. J. correctly that his engine is a common slide valve, no cut-off, and 12″x24″ cylinder, making 165 revolutions per minute, with a piston travel of 600 feet per minute, I consider this pretty high speed of piston travel, and at this speed I would not have any lead at all and would cut off at between the ¼ and ⅓ stroke, but would look sharp to the exhaust side of the valve that there was early discharge.

In conclusion will say to Mr. J. that his plant is undoubtedly thoroughly understood by himself, but the question is to explain to others who have not seen it.

But now ask for the gentleman who had something to say on this over the signature "Chief Engineer," to let us hear from him also on this or other matters. Would like also to hear from "V. M." It seems he too had a misunderstanding of this plant as well as myself.

FRANK WILCOX.

ENGINE ROOM JOTTINGS.

BY WRIST PIN.

The growling employer is bad enough, but he is not any worse than the growling employe; for the employer growls at what he thinks some one else has done wrong, while the growling employe often growls at what he should have remedied himself.

Here's a fireman growling at having to shovel in so many tons of coal per day; says it breaks his back, and is about one-half more than the man across the street has to handle. I wonder if that man ever thought that his employer was in love with paying coal bills? I wonder if he ever thought that if some one were to come along and offer to take his job and run the mill with one-quarter to one-third less coal, for the same wages, the change would be made in the traditional jiffy? I don't know just how long a jiffy is, but I think that Mr. Growler would find out before long.

Here Satterly is kicking because it takes three men to turn his engine over. Why, it is his own fault. He has that main belt laced up so tight that it fairly springs the building. It is so all over some establishments; men are complaining either about what can't be cured, or about what they should cure themselves without telling any one that they had let it happen.

* * *

I have just got back from the country; and have had a good deal of fun with the country engineers, who have been good enough to contribute to my amusement without knowing it and hence without having their feelings hurt. I struck a saw mill along the banks of a stream quite a good way from any railroad, and seeing no one who looked like a time keeper or other watch-dog, and no signs up that there was "positively no admission without permission from the office," or anything of that kind, such as one sees very often in New York, I took a saunter through the lower regions, seeking what I might devour—with my eyes. I found quite a curiosity in the way of an engine, one of the old kind—tri-weekly we used to call them, because the cross-head tries to get back the same day that it starts out—about 18x60, carrying high steam, and carrying out clear to the end of the stroke and beyond, with a fly-wheel about 20 feet in diameter and 10″ wide. This concern was hitched to a vertical gang saw, and was doing good work and plenty of it, at an expense of steam frightful to behold to us city engineers; but the fuel bill would have made any of us, or our bill payers, feel envious.

While I was watching the structure, the "engineer" came along—rough flannel shirt, trousers held up by one string, tobacco dribbling out of the corner of his mouth, sawdust in his hair, and in fact, not at all suggestive of high grade practice or any grade theory.

"Quite a machine, isn't it?"

"Very."

"There ain't such an engine within 18 miles. Oh, she's a worker! She can take all the steam that there old boiler can turn out, and the tea kittle's no toy, either. None of your chopping off steam before she's half through the stroke, like I hear a man tell me about that had been down to York. That there engine just takes her vittles right along from one end of the meal to the other; and the way that she works into them logs is a caution. Why the other day we run through a three-foot oak log and never stalled her until we got into the middle of the thickness; and all we did was just to wait about five minutes until we got an extra pressure of steam, and then we went back and took a fresh start and brought her through a humming. All you have got to do is to give her steam and she'll do the work."

Just then I noticed that the water level in the boiler was rather low, and said so.

"Oh, she seems better when she carries low water. If I just let the water dance on the tubes I can get enough steam to run two such engines with the ordinary load on. You can't make no steam when the kittle's so full. Besides the water works over into the engine when you carry so much and you might knock the head out, and then where would you be? Last year I had to run for three weeks with a wooden head, just because I was away one day and one of the help ran the engine with a boiler too full, and knocked the head into pieces the size of your hand. I pump her up every now and then, and then let her run down again."

"Don't you ever use an injector?"

"Injection? What's that? No, I never used anything of that kind."

"That's a jet apparatus. You can fill your boiler then when your engine is not running. As it is, if you stop the engine for repairs or anything, and the water gets low, you can't get any."

"Oh, if they are doing any repairs or anything and make me stop my engine, and my water gets low, I just make them quit until I get my boiler pumped up. I ain't going to have no blow-ups about my boiler."

"But on that plan either you have got to stop your repairs every now and then to let you start your engine, or you have got to unlace that main belt."

"That don't make no difference. I had sooner unlace the main belt than get blowed up—this year at any rate."

"Why don't your governor keep your speed steady?"

"Oh, that's a good enough governor; but she's got her stem bent, and if she gets full high or full low she gets ketched in the packing, and then we have to keep our eye on the throttle. When we get an extra heavy load on I just throw off the governor belt and give her all she'll take. All I got to do is not to get too far away from the throttle when the saws are coming out of the log. My hand's a good enough governor for a saw mill."

Simple faith, demanding no patented stop arrangement, no self lifting injector, no automatic sight feed cups, nothing but just a cylinder with two good heads or one good one and one bad one, and a boiler with not too much water over the tubes! This backwoods engineer had fitted apple-wood brasses to his cross-head, and was running some of the bearings around the place on hog-rind, to keep them cool; and all over the place, there was not enough science or skill to run a wheelbarrow, let alone a steam engine. Yet this man was earning his wages, and earning money for his employer, despite the surroundings—which he did not know were not as good as any one else's, handicapped by crudities that he did not know were crude. Taking what he has, he is making more out of it than those who have much more. Considering his opportunities, he is making about as creditable a showing as many of those who would scout at his clothes and his apple-wood cross-head shoes. I don't know what he would have been had he been brought to the city in his youth. I know that he would not be of much account here if he was brought here now. But one thing more that I do know is, that very few of the men whom I know would be of much more account than he is, if they were put in his place now, and perhaps few from the city would make so creditable a showing.—[Power.

An Interesting Electrical Question.

"Is dey 'lectricity in hebben, Brer. Jones?" asked Ezekiel, who had recently secured a job wheeling coal and ashes at the new electric station, and was getting very familiar with the electrical science.

"No, 'ndeed, Brer. 'Zekiel," said Pastor Jones, "all de 'lectrick lights in de town put tergether couldn't shine like de one-eyed angel. No, de Lawd need no 'lectrick light in hebben, Brer. 'Zekiel."

"Why den," answered Ezekiel, "What for' I heah yer gin out ter de congation las' Sunday a song berginnin' 'Ise goin' home t' dynamo.'"

Still Another Opportunity
Which should be improved. The Agents of the Nickel Plate will sell excursion tickets to points in the West, Northwest and Southwest, on September 26th and 27th, at very low rates. Call upon your nearest Agent.

Great Reduction In Rates.
To Denver, Col., Helena, Mont., Ogden and Salt Lake City, Utah. Ask Nickel Plate Agents.

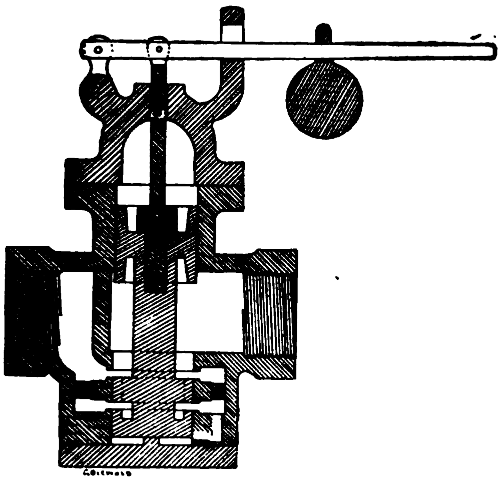
A Visit To The West.
Could not be made at a better time than now. Ask Nickel Plate Agents for rates.

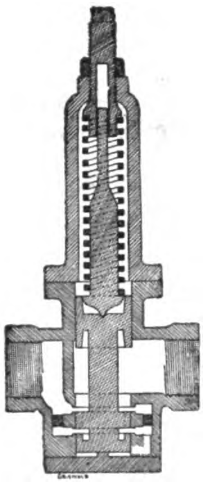
THE BURTON AUTOMATIC REGULATING VALVE.

This valve is designed to reduce and maintain whatever steam or air pressure it may be adjusted to, regardless of the initial pressure, so long as the initial pressure does not fall below the pressure it is adjusted to.

It will automatically reduce the pressure of steam, air or liquids. All sizes up to and including 2″ are made of the best composition, and all above 2″ of cast iron bushed with brass. The area of the ports when open, are equal to the full area of the pipe, so that the adjusted pressure may be maintained when a large supply is used through the valve. It will maintain a low pressure of steam or air.

The working of the Burton regulating valve is that of a valve cylinder with annular ports, and a piston valve fitted into it. This valve is so arranged as to open and close these ports, also leaving a confined space between the end of the cylinder and the lower end of the valve to receive the reduced pressure to operate it. By referring to the sectional view, it will be seen the high pressure enters the valve through the induction pipe into the valve cylinder between the two pistons. The pistons being of the same diameter it is powerless to move the valve until it passes through the annular ports to the outer chamber or low pressure side, and as soon as the low pressure the valve is adjusted to is obtained, it will, by means of the small port leading from the low pressure side communicating with the confined space below the valve at the end of the cylinder, operate on the end of the piston valve, forcing it shut against the means for forcing it open. As soon as the pressure weakens, it also weakens on the end of the piston valve, and the means for forcing the valve open will force the valve down and let in more supply to maintain the adjusted pressure.





There are two styles, one for marine and the other for heating purposes. C. H. Burton, cor. Main and Center streets, Cleveland, O., is the inventor, patentee and manufacturer.

Harvest Excursion.

Now is the time to go to points in the Northwest, West and Southwest, as the Nickel Plate will sell excursion tickets on September 26th and 27th at special rates. For full particulars call upon, or address the nearest Agent.

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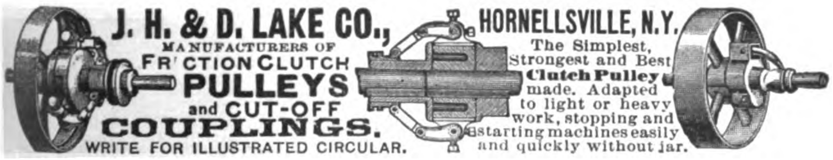

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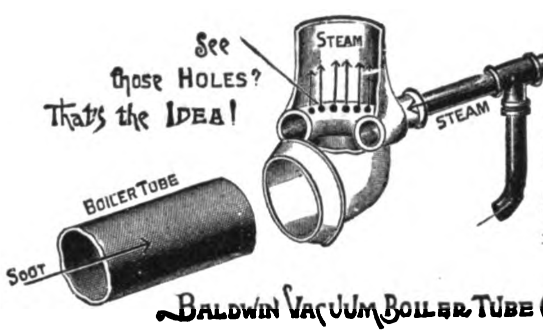
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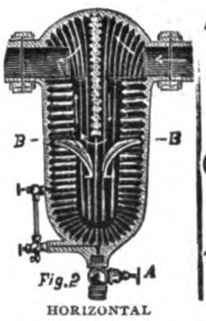

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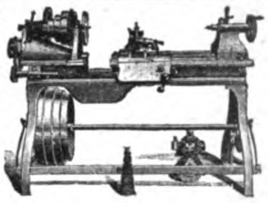

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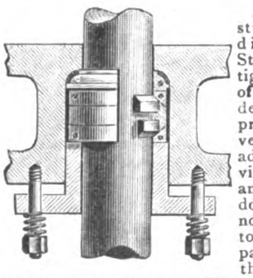

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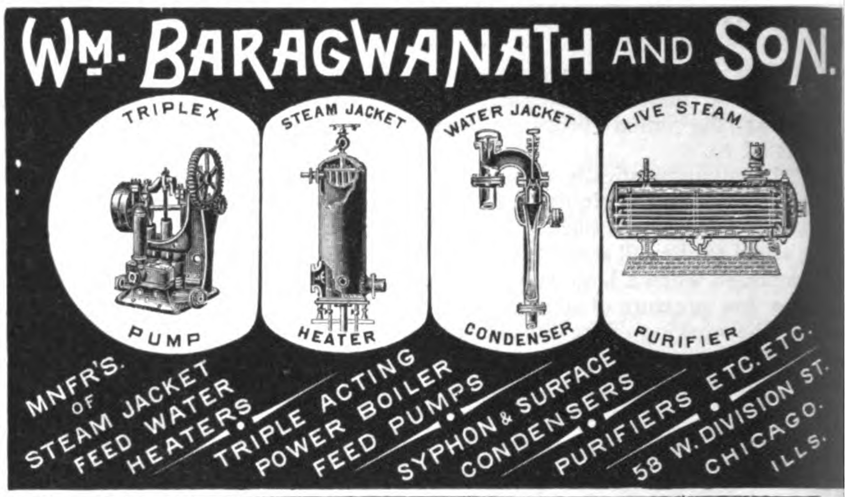

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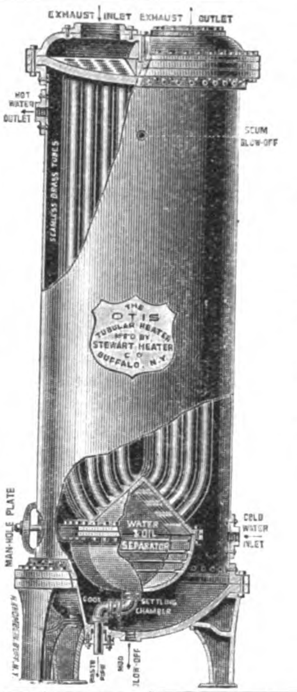

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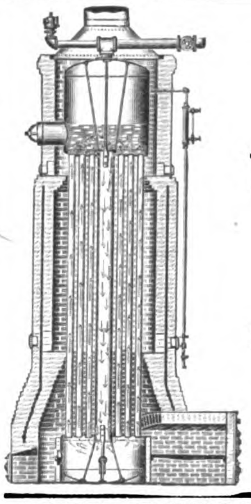

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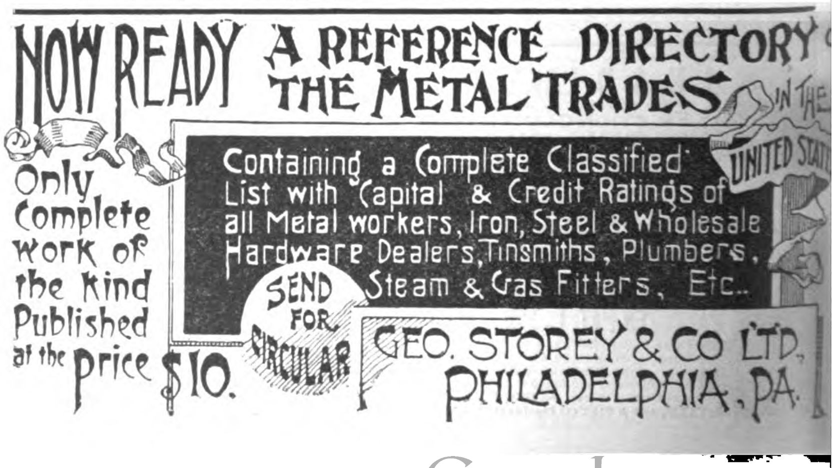

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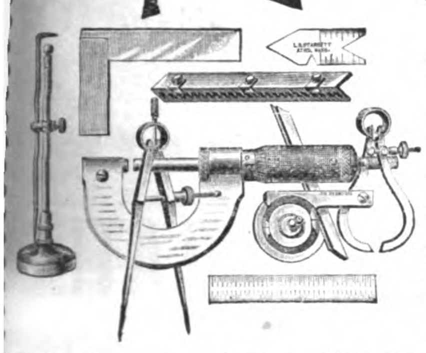

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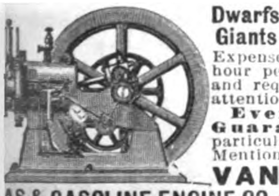

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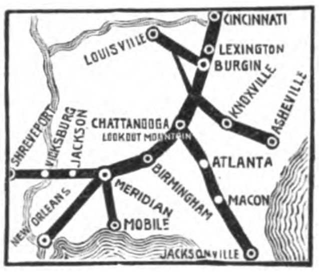

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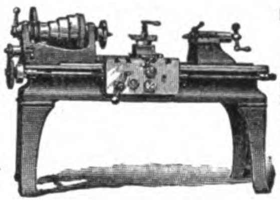

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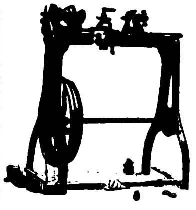

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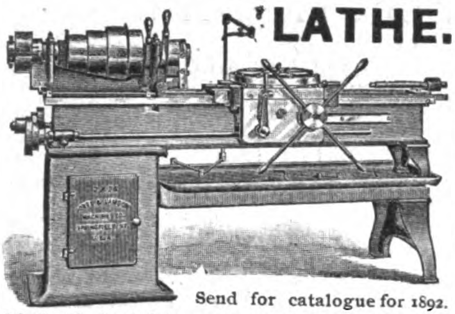

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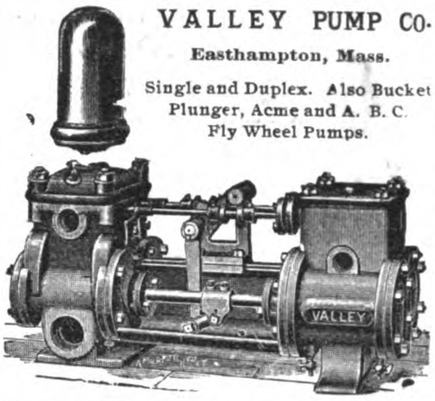

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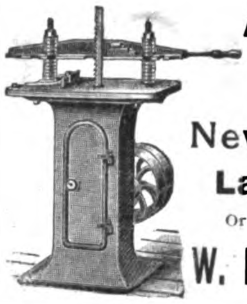

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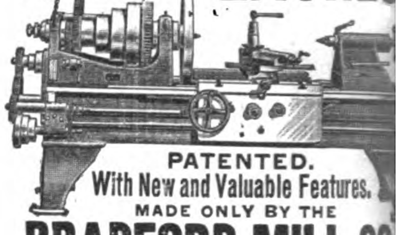

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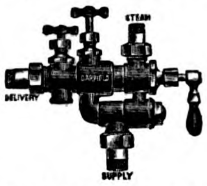

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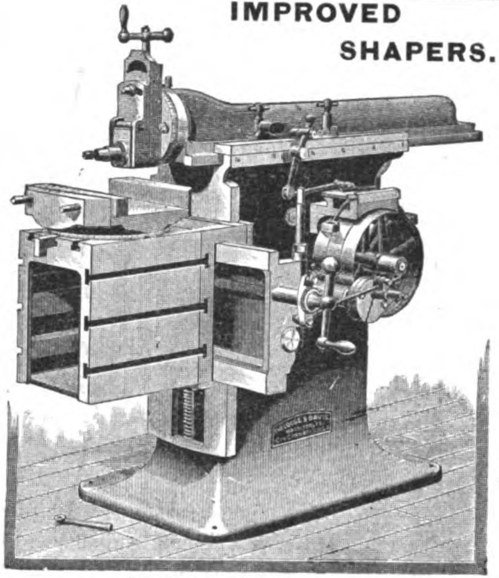

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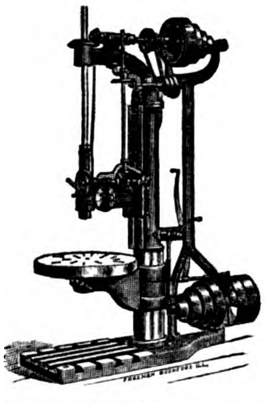

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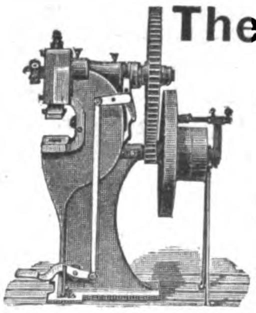

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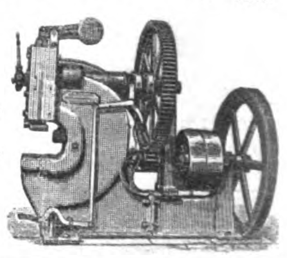

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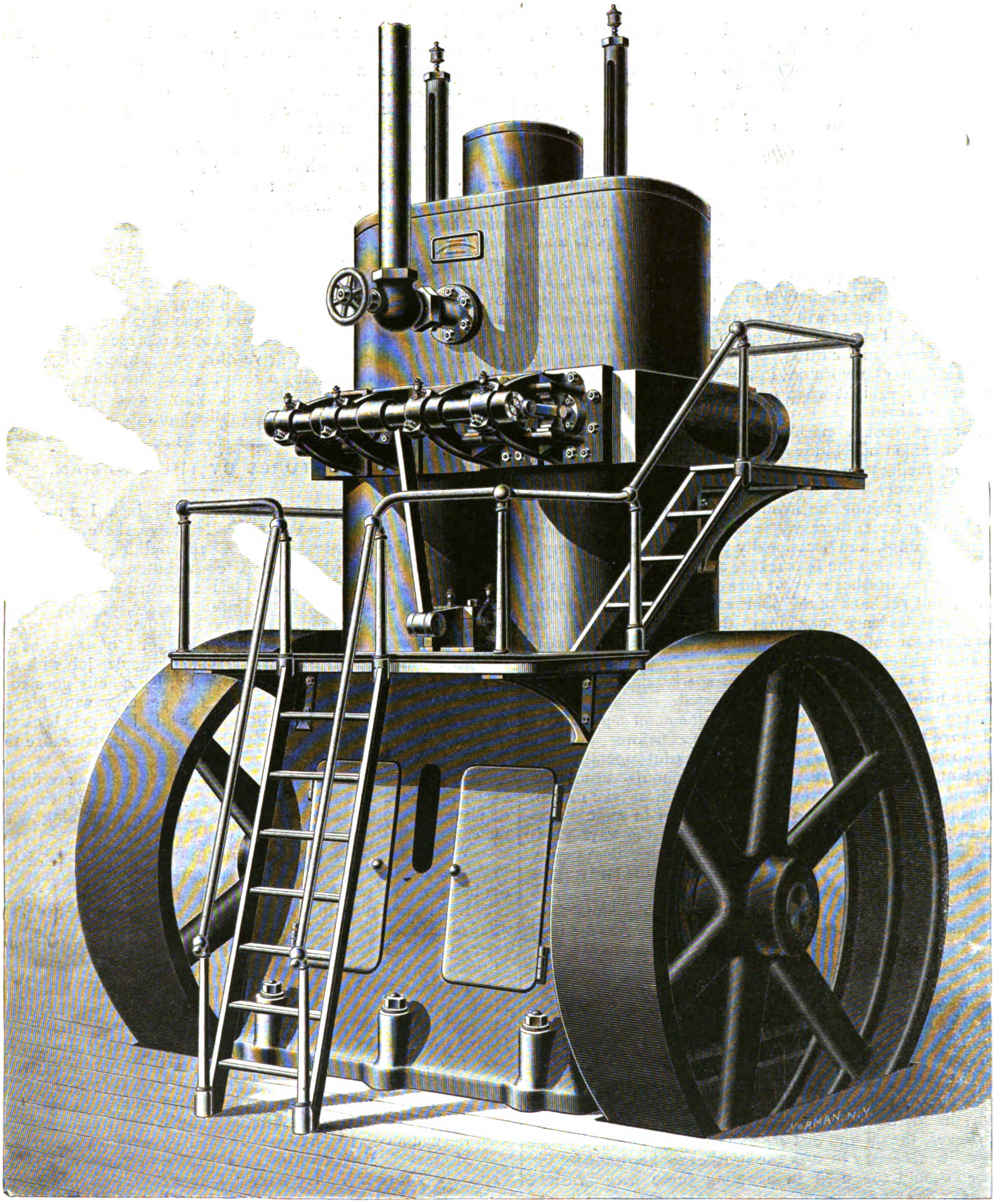

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to secure economy in fuel, and to utilize the higher ranges of expansion, either as a condensing or non-condensing engine. There are many places where it is not practicable to use a condenser on account of the scarcity of condensing water, as it is possible to secure about the

(Continued on page 8.)

Electrical

Suggestions to Engineers on Tending Dynamos—Electrical Terms Explained.

Place the oil-catchers under the drip of the dynamo bearings, and never allow them to overflow on the floor.

Keep the floor of the dynamo room swept clean, so that no nails or other small pieces of metal can be drawn into the armature.

Never use or leave iron or steel tools near the machine, while at work, as these are also likely to be drawn into the armature if left too near it.

Oil cans made of copper or zinc are best for use about electrical apparatus.

Never allow oil to accummulate on the armature or shafts of the dynamo.

When the wires coming out of the shaft to the commutator become bare from cleaning, they should be recovered with kerite or okonite tape, or gum cloth, and shellaced, and allowed to dry for about eight or ten hours before being used.

If the shellac on armature bobbins, or field magnets becomes worn off, these parts should be reshellaced.

A good bellows will be of service in getting dirt out of the crevices of the armature, and around the commutator and rockers.

If the rocker springs are fastened to a wood base, see that the screws which hold them are kept tight as the wood dries.

See that all thumb screws in the binding posts are kept screwed down tight on the wires. Special care should be exercised in regard to this in the case of incandescence machines.

In placing brushes, take pains to clamp them firmly in position, allowing them to rest squarely and evenly on the commutator. Be very careful not to screw down one side of the clamp tighter than the other, but clamp them evenly, so that both edges of the brushes will be held in place.

The clamps holding the brushes must be perfectly clean, so as to make good contact.

Brushes must bear on the commutator with a reasonable pressure, not too hard, nor so lightly as to allow them to flap or chatter. Occasionally, by accident or otherwise, the brushes will get bent, or sprung, and bear too lightly on the commutator. This condition of affairs is always attended with many sparks, and a very rapid cutting, or wearing of commuator segments. In fact, segments may be worn out in a few days, in this way.

If brushes are perfectly straight when put into the clamps, sufficient pressure will usually be obtained.

In an arc light, or high tension machine, if the brushes are rocked too far forward in the direction of rotation of the commutator, the sparking will quite disappear, but the lights will go out occasionally, each extinction being attended by a few, very long sparks on the commutators. This trouble may be corrected by rocking the brushes backward a short distance. If brushes are moved too far back, there will be sparking, and a consequent diminution of light in the lamps, and occasionally extinctions of the lamps, similar to those which occur when the brushes are too far forward.

The proper point for the brushes is as far forward as possible, so as to make the sparks small, and yet back of the point where flashing will occur. In low tension, or incandescence machines, the brushes should be adjusted to show no spark, or only a very minute one, otherwise, the wear on the commutator and brushes will be very heavy.

Too much oil on the commutator will cause sparks similar to those which appear when the brushes are not properly adjusted.

When brushes are worn nearly through, clip them off squarely at the worn ends, and move them up to the same position as before.

Cleanliness is absolutely necessary to the successful operation of an electric lighting plant. Too often the salesmen of manufacturing concerns give the impression that an electrical plant will almost take care of itself, and that it does not matter where you put it, whether in some out-of-the-way corner, on a shelf, or anywhere, so that it is not in the way. It is not reasonable to expect this of a dynamo machine, any more than of any other fine piece of machinery. Treat your electrical apparatus fairly; give it a location that shall be as clean as possible; grant it some attention, and you will be better satisfied. Poor and dirty oil will cause hot bearings, rapid wear, etc., and is, of course, much more expensive in the long run.

The commutator is a very important part of a dynamo, and should be given special care. It is well to wipe it off frequently with an oiled cloth, and whenever the machine is shut down, carefully brush off any particles of dust or copper which may have collected about the connecting wires, or other parts of the commutator. Should your brushes be of the style composed of a number of wires, soldered or bound together at one end, you will find that they have a great tendency to collect dust, copper fillings and oil, which must be cleaned out. If they are attended to immediately after shutting down the dynamo, boiling water will generally clean them nicely. If, however, the oil and dirt are allowed to become dry and hard, it may, perhaps, be necessary to soak the brushes in kerosene oil for several hours. Care should be used in handling these wire brushes to avoid bending, as when bent, some parts of the brush do not do their work, and others are obliged to do much more than their share.

There are some places about a dynamo where oil will do more harm than good, as, for instance, the connections of the fields, and in and around the armature. It will sometimes work its way into the latter place, if care is not used to prevent same. In time the oil is apt to rot the insulation, and the constant collecting on this sticky surface of dust and metal particles, tempt the current to break through the rotten insulation, resulting in a burned-out magnet, armature bobbin, or perhaps the entire armature.

Contacts of all kinds should be examined occasionally to see that they are bright and clean, as poor contacts make high resistance, and hence call for more power. They are also liable to heat up to a dangerous degree, this heating sometimes being so great as to cause a fire.

It is hardly necessary, we presume, to mention the fact that to obtain a clear and steady light from arc lamps, the carbon rods, as well as all other working parts of the lamps, must be kept perfectly clean, and in condition to work freely and promptly. The contact points in the cut-out mechanism should always be bright, so that in case they are called into action, a good firm contact will be made. A clean globe may, perhaps, not be absolutely necessary to the proper working of a lamp, but it certainly looks much better and offers no obstruction to the light.

No sooner has a dynamo been installed in a factory, or, we may say that as soon as its installation is completed and negotiations opened, we begin to hear about amperes, volts, ohms, megohms, etc., etc. It may, therefore, be of interest and profit to consider, briefly and simply, the meaning of these terms, as, when they are clearly understood, other matters are grasped more readily.

E. J. Houston, in his "Dictionary of Electrical Words, Terms and Phrases," states: "The ampere is the practical unit of electric current. Such a current (or rate of flow or transmission of electricity) as would pass with an electro-motive force of one volt, through a circuit whose resistance is equal to one ohm. That is to say, a current of the definite strength that would flow through a circuit of a certain resistance and with a certain electro-motive force. Since the ohm is the practical unit of resistance, and the volt the practical unit of electro-motive force, the ampere, or the practical unit of current, is the current that would flow against unit resistance under unit pressure or electro-motive force."

The ohm, as mentioned above, is the unit of resistance, and the volt the unit of force or pressure. A very simple and easy way to fix in one's mind these terms and their meanings, is to take the common illustration of the flow of water through a pipe. We will assume, for convenience, that we have a pipe one inch in diameter, and, say, five feet long, offering to whatever liquid is to be put through it, a friction of resistance of one ounce. We now wish to put through this pipe one gallon of water, and, therefore, must have a certain amount of pressure to accomplish this result. Let us say that it requires a pressure of one pound to push the one gallon of water through the pipe mentioned, the friction resistance of the pipe being one ounce. Transpose this case into an electrical question, and it would be about as follows: The one gallon of water would represent one ampere of current. The friction resistance in the pipe would represent one ohm, and the one pound pressure would represent the electro-motive force (e. m. f.) necessary to drive the one ampere of current through a given length of wire having a resistance of one ohm.

The term megohm is formed simply by the addition of the prefix meg, or million, meaning, therefore, one million ohms.

LECTURES BY THE OLD MAN.

I have been considerably interested in Jack Loftus, who manipulates the 60" lathe in the lower shop. Not that there is anything particularly uncommon about Loftus, except when anything occurs that disturbs the harmony of the machinery for a few minutes, instead of folding his arms and searching for a soft place to lean against, he goes where the trouble is located and helps get things in motion again, or else he uses a piece of waste cleaning off the soiled spots on his lathe.

Then, too, I have noticed that when one of the cubs gets puzzled as to the best method to employ on some particular job with which he is not familiar, and the foreman is not near by, he quietly goes to the cub, their heads get together, Jack makes a few gestures with his arms, the cub brightens up and goes about his work, while Jack gets back to his big lathe in such a didn't-miss-you manner that it is hard to realize that he and the cub ever saw each other.

Then at the noon hour when most of the boys are flippantly roasting each other and bolting their lunches, Jack puts his meal out of sight with deliberation and enjoyment and is debating something with other shopmates.

While he has some decided opinions of his own, too, he carefully listens to those of others, and gives and takes in argument with the same deliberation and pleasure that he masticates his food.

But I have noticed a new wrinkle in Jack during the past four months and mentioned it to Brailey, the foreman over that department, but he seemed to think Loftus was a sort of "crank," "so different from the rest of the men, you know," said he.

By the way, I am not perfectly satisfied with Brailey as a foreman. He is ambitious to get on and all that, but he is not my ideal; he is too much of a plunger, and I have to take excuses too often instead of results. I have tried to discover the proper niche in mechanical work where he would be suitable, and where I can place him without destroying his ambition.

But to get back to Loftus. Jack got into a habit of talking to himself, shaking his head, and then hitting some inoffensive casting a vicious blow with his hammer when he would partially regain his normal condition.

Matters focussed two weeks ago when he came in and said he wanted to "talk" with me. He said, "I want to get off for about two weeks or

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ten days; I've spoken to the foreman, and he says you can't spare me; now I want to have my say and then you can have your say. Probably you have noticed on your going home from the shop evenings that little woman and the two babies sitting on the door step of the little house on the corner of B street. Well, they are mine, as we call it, and I have a scheme. I know a man who went down to the seashore last Summer and got good board and lodging for only one dollar a day, so I have held back all my overtime and extras for the past four months, and I have $60 that my wife don't know of; I am going to take her and the babies to Rockaway and let them roll in the water and dig in the sand while the sixty lasts, and see what the effect will be. I don't imagine that we will have rooms en suite with bathe attached; neither will we be served at tables by servants of polished ebony with white apron trimmings, but we will have an opportunity to see the ocean and taste the saltiness thereof and forget, as it were, all about belts and pulleys, and the daily grind of shop and household duties, and see if things won't go easier after we come back. What do you say, do I get off?"

I had noticed the little woman and two babies as Jack expressed it, although one of the "babies" was a sturdy little chap of five years whose sole aim in life seemed to be to get the family cat hung on the front gate. I recalled the faded, tired look on the face of the little woman as she talked baby talk to the pale restless infant in her arms while awaiting the husband's evening home coming.

Jack had never gazed upon the ocean and I had. Judging from my own experience in days gone by I did not think his "sixty" would go very far, but I was interested in seeing the experiment worked, so I said: "Jack, your scheme looks so good that you can lay off while the $60 holds out, and I would like also to invite myself to go along with yourself and Mrs. Loftus on this seaside outing. It may be beneficial for me also to commune with nature instead of mechanics for a few days; would I intrude?"

Jack didn't faint away at my proposition, but recovering from the stagger it gave him, I was invited. We arrived at Rockaway on Thursday and rolled in the brine while the children burrowed after sand crabs until the baby was the color of a beet, while the five-year-old looked like a Turk and had an appetite like an ostrich. Loftus spent the hours when out of the water sitting on the beech, gazing oceanward until his eyes bulged out like opera glasses, while his timid little wife hunted shells and odd sea curiosities.

When I suggested that probably they might find added pleasure spending the afternoons and evenings among the museums and concert halls, the flying Dutchman, the razzle dazzle, and the hundred other attractions that take nickels from our pockets, Jack fired up and said, "Old Man, see the color in that woman's face? See those two kids? That's all we want; I can get all those other rackets at home if I want 'em; I came here to have my family enjoy salt water, sand and tan; we are doing it great."

I bothered him no more, but helped the two cherubs build sand castles and paddle in the breakers until the tenth day, when Loftus packed his grip-sacks, and, taking the two babies in his arms, said, "Let's go." In the evening, after he had stowed his treasures away in their berths, he came into the smoking room of the sleeper where I was enjoying my cabbage. I gave him a cigar and asked, "Jack, how much over the sixty did it take?" "Two dollars and thirty cents less than sixty," he replied. "Pretty good scheme, hey?"

Loftus showed up Monday morning as usual; instead of his previous "queer" actions there was a twinkle of contentment in his eyes. Undoubtedly his scheme was a paying investment.

I believe every man and boy around the plant has been up to the cottage on B street, "hefted" the boy, admired the baby and complimented the blushing Mrs. Loftus on her improved looks. I also understand there is to be a general hegira to the seashore next Summer by the employes of this firm; from general manager down to the youngest cub. I also notice a slight improvement in both quality and quantity in work produced in the shop. Yes, it paid.—[The Old Man, in American Machinist.

Railroad Marvels.

If all the locomotives in the United States were coupled together they would make a train of solid iron and steel 300 miles long. Add the passenger cars and we would have 300 miles more of wood and iron. This would give us a gigantic passenger train 600 miles in length, counting both engines and cars. Should we want a huge "mixed" train we might add the "box," "flat," and every other kind of freight car, and our train would then have a total length of over 7,000 miles. The passenger cars in this gigantic train would be capable of seating 1,500,000 people, and upon the freight cars could be loaded the weight of the pyramids of Egypt and all the State capitols of the United States besides.—[Courier-Journal.

SOME doubts are entertained as to the desirability of employing electric motors in collieries. One of the objections which have been raised is the possibility of gas explosion being caused by a spark occurring at the communicator of the motor where the electric current is conveyed into and out of the rotating armature by means of the brushes; another objection is the use in the pit of driving belts, which not only take up space, but cannot be kept in good working order in dirt and damp situations.

THE Gatling gun is now worked by an electric motor in the American Navy. The Motor is attached to the breech of the gun. Hitherto a couple of men were required to serve the gun, one to train the piece and drop the shot, the other to work the firing crank; but now one man is sufficient. By touching a switch he can train and operate the gun at will, so as to fire either a single shot, or at the rate of 1,200 a minute.

STEEL MAGNETS lose their permanent magnetism at the boiling point of almond oil.

CUPOLA PRACTICE—I.

BY VICTOR COLLIAU.

The cupola is a furnace to melt iron in a foundry. It has been known for centuries, and is carved on Egyptian monuments 4,000 years old. The founders of that time are represented using bellows very much similar to ours, to produce the strong blast necessary to melt metal. The metal to be melted was thrown on the top of a pile of fuel which had been previously lighted. The blast was then introduced at the bottom, through one or more pipes or ducts called tuyeres. This is what we are doing yet, in the modern cupola.

Some of the old cupolas were made of stones, some of wooden staves, some of bricks hooped like barrels, and were lined inside with stone, fire-clay or refractory sand; later they were made of cast iron staves, and only recently of boiler plates riveted together. It is but lately that special study has been made of the proportional dimensions of the cupola.

At the present day many large cupolas are used for small meltings, and small ones for work much larger than their true capacity. The proportions and sizes of the furnace, the quantity and quality of fuel, metal and flux, and the quantity and intensity of pressure of cold or hot blast produce different results.

In the smelting furnace the iron ore is transformed into pig iron.

In the Catalan furnace wrought iron is produced directly from the ore.

In the foundry cupola pig iron and scraps are melted to be cast in moulds to make castings.

In the steel works the molten metal from the cupola goes to the converter to be transformed into steel.

DESCRIPTION.

The modern cupola generally consists of:

(1st.) *Foundation.*—The cast iron foundation is composed of a foundation plate on which are four legs and over them the bottom plate, all bolted together. The legs differ in size according to the use of the cupola.

In stove and hardware foundries where small ladles are used exclusively to carry the molten iron from the cupola to the molds, the legs are made two to three feet long.

In machine shop foundries using large crane ladles, to contain two to ten tons of molten metal, the cupola requires legs four to five feet in length.

In car wheel foundries, the cupola has a large reservoir in front, from which small ladles are filled, each one containing the iron necessary to cast one wheel; the legs of such cupola are seven feet in height.

In steel making foundries the molten iron coming out of the cupola is first put in a reservoir. From the reservoir the metal is conveyed to the converter to be transformed into steel, and from the converter it is emptied into ladles for casting to ingots, or put into molds for making cast steel castings. These cupola legs are about 22 feet long.

On the top of the legs rest the bottom plate, which has a circular opening in the middle with a diameter equal to the inside diameter of the brick lining of the cupola, this circular opening is closed by a door made of one, or more often two pieces hanging to the bottom plate.

When the cupola is ready for working the bottom doors are closed and a round iron bar propped under them. When the casting is finished the iron bar is pulled out by means of a long iron hook. The door then falls downward and the contents of the cupola drop on the floor. This is called "dropping the bottom."

The cast-iron foundation rests on very strong masonry built below the ground floor. The weight to support is considerable, and it must be at least a foot wider than the foundation plate.

For small cupolas the foundation should be from three to four feet deep and from six to eight feet for the largest. If the ground is soft or of filled earth, piles must be driven before the masonry is built.

(2d) *Stack.*—On the cast-iron foundation above described, stands the cupola which is sometimes called the stack. It is a cylinder made of boiler plates riveted together, and lined entirely with fire bricks, from the bottom plate to the top.

At the bottom of the stack and at different heights are several openings, of different sizes and forms. One is called the tap hole, another the slag hole and others tuyeres. Several feet above these are the loading doors.

The tap hole is to let the iron out when melted, it is generally on the side facing the moulding room. When the cupola is to small for a man to stand in to fix the bottom before the fuel is lighted, an opening is left in front about 18 inches square. This is closed by a door made of boiler plate and is held in place by an iron bar resting on hooks. At the bottom of the door is the tap hole.

The slag hole must be on the opposite side and above the tap hole. It is used to let out the slag, which floats on the moulton iron of the cupola; it is also used to let out the molton iron, when the cupola is filled to that height, to prevent the iron from running into the tuyeres. This is the time to tap. The holes of suyeres are above the slag hole, they are opening to let the air into the cupola by means of pipes connecting with a blower.

Between the tuyeres and the blower there is a blast gate to regulate the pressure of the blast in the cupola, and between the blast gate and the tuyeres a blast gauge to show the pressure of the blast which enter the cupola.

The loading doors are for the purpose of introducing the metal and the fuel into the cupola.

This is a general description of the essential parts of any cupola.

W. H. RATCLIFFE, of Orange, N. J., has succeeded in discovering a process whereby aluminum may be soldered. Using this process, he proposes to manufacture an aluminum bicycle. He expects to bring the weight of a bicycle down to 15 pounds and still have it strong and durable. Steel is to be used in the parts where the greatest wear comes or where great rigidity is required.

SCIENTIFIC MACHINIST

Formerly, WESTERN MACHINIST.
DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES.
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The publishers of the SCIENTIFIC MACHINIST are interested in nothing but this newspaper, which is conducted for the sole purpose of earning legitimate profits. They have no goods to sell, no scheme of any kind to promote, through the medium of this journal's circulation.

THE SCIENTIFIC MACHINIST goes only to subscribers who have paid for it. Sample copies are sent out liberally, because by that means new subscribers are procured; but there is no "free" list except that of exchanges.

It is the duty of all men engaged in mechanical pursuits to assist their fellow workmen as much as possible. They can do this in no better way than to write and send to the publishers of mechanical papers the results of their experience and experiments. Plain and brief descriptions of how difficulties have been overcome, how economy has been effected and how progress has been made are helpful and valuable. The publishers of the "Scientific Machinist" cordially solicit such communications from all readers. None shall go unnoticed.

ENTERED AT THE POSTOFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER.

CLEVELAND, OHIO, OCTOBER 1, 1892.

☞The Cleveland News Company will supply the trade with the SCIENTIFIC MACHINIST, through the regular channels of the American News Company.

CERTAIN changes in the make-up of the SCIENTIFIC MACHINIST will be inaugurated with the October 15 issue, and that number may, in consequence, be a little late, not however, unless positively necessary.

SHUT OUT THE ITALIANS AND SLAVONIANS.

The threatened cholera epidemic serves as another forcible illustration of the monstrous injustice of permitting ignorant, half-civilized, monarchy-ridden foreigners to come to this country by the drove, to impoverish American citizens of native and foreign birth. This negligence is responsible not only for the introduction of the dread Asiatic plague, but also for our labor troubles and many of the bad features of our politics and society. The inaction and apparent supineness of our federal authorities in permitting this is most strange. It is well known to all members of congress that the great mass of American citizens look upon the influx of the degraded classes now coming to our shores as a great menace to our prosperity and the body politic. They know that there is nothing their constituents as a whole would be more pleased with than a law effectually closing our boundaries to this invasion, but they are stricken with a cowardly and utterly senseless fear that a vote or a speech in favor of such a law would call forth expressions of displeasure from some anarchistic, depraved festers of foreign origin. They disregard the wishes of those who elect and pay them to curry favor with demagogues and monomaniacs. Does any sane person suppose that the intelligent Irish, Scotch, Scandinavians and Germans, wish to be forced out of employment by the Italians, Slavs, Poles and Russians? If the restriction of immigration meant the shutting out of their own nationalities, they might oppose, politically, the congressmen who voted for it. We say they might, for we are not sure that they would not consider it a good thing. But the immigration is not now from Ireland, Scotland, Sweden, Norway and Germany. It is from Italy and Slavonia, countries as alien to them as Turkey.

This is a crying abuse, and great will be the price America will pay if she does not throttle the evil at once. Men who work for wages should agitate it in and out of season. Bring it up every day. Talk it at the ward and township caucus, at the convention, at every place where their are fellow citizens to listen. They have it in their power to cause legal enactments that will turn back the horde that is robbing them of their wages. Let the issue be taken up and the battle waged until the cattle that come here to plunder American workmen, only to return to Europe when a few hundred dollars are, by beastial living, hoarded up, are kept out by the arm of the law.

No effort should be spared to make the meeting of the street railway men, which is to be held in Cleveland this month, a succes. Cleveland has advantages as a convention city which have not been adequately appreciated. Let us make every gathering in our midst of this nature, an advertisement for us. The conventions of the mechanical, electrical and railway men are now considered very desirable.

Questions and Answers

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(440.) "Reader," Cincinnati, O., writes: "Can you inform me through the lines of your valuable paper what process is used for putting etchings on saws? Is the old process of engraving on wax surface used, or is there any new process?" *A.*—The process of covering with wax and scratching through it is good, if skillfully done. You can paint the parts which are not to be etched with asphaltum instead of waxing the surface. This, however, is better adapted to etching around letters so that they will stand out instead of being sunk. Draw or stamp the name on the saw, paint the letters with asphaltum, also the surface outside the border. Then dip in acid and etch out the initial inside the border. Two etchings should bring the name out plainly. Change the acid often when etching by any process and wash out the creases with water, for the metal eaten away forms an oxide and renders the steel impervious to acid. Washing removes the oxide.

(441.) Albert Kopf, Dayton, O., writes: "Will you please inform me where I can get a paper or book on tool making?" *A.*—We do not know of any book devoted especially to the subject of tool making. Rose's "Practical Machinist," $2.50, has considerable information of value on tool making; and we also find considerable information in Richardson's "Practical Blacksmithing," four volumes, price, $1 per volume. Both of the above books can be furnished by Henry Carey Baird & Co., 810 Walnut street, Philadelphia.

(442.) F. W. asks: "Will you be so kind as to publish in your valuable paper the rule laid down by the government how to find the safe working pressure to be allowed on the stay bolts on a marine boiler? My understanding is that a bar of good 1" iron will withstand a tensile strain of 24,000 pounds without rupture, and by this we have a starting point. Then, if we desire to find the safe working pressure to be allowed on a $\frac{5}{8}$", $\frac{3}{4}$" or $\frac{7}{8}$" round stay bolt, that we must first get the area contained in the stay bolt we are working on, and find what tensile strength it contains, allowing the 24,000 pounds to the square inch and then take one-sixth of the result. Now, I wish you would do this problem in just as simple a form as possible, as I am sure there are many who have long looked for the answer." *A.*—This was answered in the issue of August 1, '92, question 411.

(443.) J. C. Dubois, Muddy Creek, Pa., asks: "Can we make shot by pouring the melted lead through a sieve in the tower or a barn 50 feet high? We would expect to catch it in a tank of water, of course. If necessary, we would drop it from a cross tree of a mast we have, over 100 feet from the ground." *A.*—The latter height would be neceesary, and we are not sure that it would be sufficient. Take a tin basin and perforate holes in the bottom. An ordinary colander is about the thing. Let us know what kind of shot you get.

(444.) T. V. C., writes: "Please let us know where wood split pulleys can be bought, and who make the best?" *A.*—An examination of our advertising pages will answer the first question. The second is a matter of opinion.

(445.) R. J. Birch & Co., Ill., write: "Please let me know how to japan castings. I suppose this knowledge is very general, and the inquiry may look very simple in us, but if not worth space in the paper please refer us to some book where the information is given." *A.*—After being thoroughly cleaned, apply a coat of boiled linseed oil. When about dry they should be baked in an oven of the proper temperature to turn the coating black, leaving it, however, unburnt. We cannot give instruction how to regulate the heat—this must be ascertained by experiment. But to avoid blistering it should be moderate at first and increase gradually. If properly done, the castings will come out with a good polished black japan coat.

(446.) O. N. E., Muncie, Ind., writes: "Will you please give your opinion in regard to the following: Has a vertical engine any more power than a horizontal, both being of the same size?" *A.*—No.

(447.) John Stoufer, ———, Ct., writes: "I am a young engineer and wish to become competent to handle a lighting plant. I have here no opportunity of learning this, and I wish to know whether it will be necessary for me to go to a technical school. I cannot afford to do so." *A.*—We often receive such inquiries as this, and in answer to all in such a position will say that it is not *necessary* to attend a technical school in order to become competent to run a power and lighting plant. Such a course would be of great help, but if a job is procured in an engine room having a lighting plant, and if effort is constantly put forth to master the details of engineering, by observation, practice and private study and reading, one can make a competent engineer of himself.

☞ Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[ED.

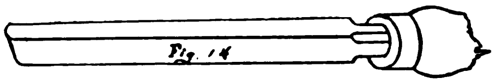
AMATEUR AND APPRENTICE.—III.

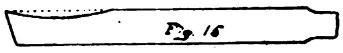
BY EDWIN WOODWARD.

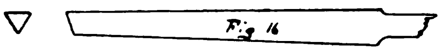
In turning very hard woods, such as rosewood, ebony, lignum-vitae and others of like texture, the very thin edge of the wood turning gauge and chisel does not contain sufficient metal to stand up to the work, and there should be substituted for these other tools, more after the forms of those used in turning bone and ivory. Of these, the first tool, and the most important, is the round nosed tool, Fig. 14. This tool is made in a variety of forms as to the cross section of its body, the workman selecting the style best suited to his fancy. It is ordinarily made of a square piece of steel, but tapering from the shank to the point, whose width should be such as suits the nature of the work and the strength of the lathe, but in no case should the point be so wide as to cause the body to spring under a cut the full depth of the point curve.

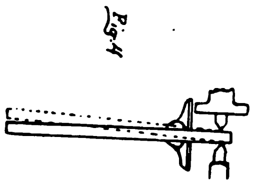
The rest, for this class of work should be placed nearer on a level with the center of the work, slightly above it, and quite close, and the tool should be ground with a little top rake, which is indicated by the curve on the top of Fig. 15, being ground so by holding the tool with its top side, directly upon the face of the grind stone and in line with its motion. For such grinding, a small stone is used, and consequently an emery wheel is ordinarily employed, about 6″ in diameter. The clearance given beneath the cutting edge should not be more than 30° back of a right angle with the body of the tool, for this will give a sufficiently acute cutting edge and also retain a sufficient amount of metal to support it under the strain. The tool is used principally for the same purpose as the gauge, for removing surplus stock, etc., but while the point of the gauge inclines upward 30° or more, the position of this is nearly horizontal.

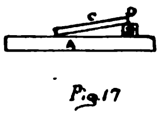
A round nosed tool, made of triangular stock, finds most favor with the writer. The cutting edge is made on one of the flat faces as Fig. 16 indicates, the sharp V edge coming in contact with the rest. Its shape permits the operators giving its side faces any degree of clearance from nothing to a right angle, while the sharp edge prevents the tool from slipping sideway under heavy duty. A three square file is often pressed into service for this tool, as it is difficult to forge a triangular tool without a die or gauge block. But to be of much service, the temper in it must be drawn, or it will not have sufficient strength and will be apt to break and injure its user. After removing the teeth marks and shaping its points, harden by heating it to a low red in a clean coal fire and plunging about an inch of its point in water for several seconds, removing it, and polishing quickly with a coarse whetstone the cooled portion, leaving the hot shank of the tool and the oxygen to paint the color of the temper on the point of the tool, the straw color coming first, followed in succession by yellow, orange, purple and blue, in all their varying shades. And where at the point of the tool the purple seems merging into the blue, but with only a hint of its presence, dip quickly into water to hold it at that temper, which will be found right for the hard woods, ivory or bone, and will usually do very well for brass or iron, or even thoroughly annealed steel.











A few more suggestions on hardening and tempering may not come amiss at this stage of advancement. The amateur undoubtedly will have much of it to do, for tools will break, and have to be repaired. Others will come too soft or hard and require tempering anew, and the apprentice, even if not permitted to do this important work himself, may from the knowledge gained, advance in favor with his foreman by being enabled to use to greater advantage a tool, from a glance at its strength and temper, as indicated by the tempering color and thus make progress, where without a knowledge of conditions, disaster would result.

Nearly every one knows something of the action of fire and water on steel, and to such as do not, it may be said that if a piece of steel be heated red hot and plunged into a bath of cold water, by being thus quickly cooled, it contracts the grains rapidly and consequently is much refined and is very hard, and the degree of hardness depends upon the amount of carbon it contains. The learner should not be led into the belief that Bessemer or machinery steel can be hardened and rendered serviceable. They do not contain a sufficient amount of carbon. The amount of carbon in steel varies from one-half of one per cent. in low grade to one and one-half per cent. in high grade, this latter usually being the grade classed as tool steel. A high grade of steel melts more readily than a low, and consequently great care must be observed in forging and hardening. If the steel is allowed to get hot enough for sparks to fly, it is at the point of fusion and that portion is practically worthless for tools, and should be cut off and cast away, and the remaining portion used more carefully.

The tool should be forged as nearly the exact size and form as possible, so that the outside portion of the steel that is refined by hammering may not necessarily be ground away or otherwise removed to bring the tool to the actual shape for duty. Many smiths are very negligent in this respect. The writer has often seen a workman grind fifteen or twenty minutes to bring to shape a diamond tool for the lathe for hardening. Because of this neglect, at the expense not only of the time lost, but of a good tool, the best part of it is ground away. As before stated, a bright red heat, quenched with cold water, will make a piece of tool steel very hard and brittle and so is worth very little except for the lightest service. The rapid contraction caused by its bath makes the scale of oxide peel off and separate from the steel, as it can contract but little, and the steel comes from the water a whitish gray, this indicating great hardness, and suited only for metal scrapers or other hand tools of like nature, and so the temper must be drawn because the steel is glassy brittle. It is best to become familiar with the temper of steel by color before attempting to temper a valuable tool, and the easiest and most practical way is to prepare a scale from a piece of flat steel, one-fourth inch thick, one inch wide, and six inches long. Heat this piece carefully till it is red, and quench by dipping in cold water vertically, end first. Grind one side to a smooth bright surface. Heat a heavy plate of iron, one inch thick, to a red heat. Fig. 17 shows the full apparatus. Have at hand an iron block B to lay upon plate A when removed from the fire, and upon both lay the bar of steel C, with bright side up, and inclined as shown. The part of the steel bar in contact with the plate will heat first and gradually extend its warmth upward. The first color noted will be a very pale yellow or straw color, seen first at the point of contact between the plate and bar. As the heat of the bar increases the color of that point deepens to a bright yellow, while the straw color creeps farther up the bar, to be followed by an orange, a purple, and a blue by easy gradings, each following its leader up the bar, and when the heat at the lower end has made the steel a deep blue, it should be dropped in the water to cool, when a steel of graded hardness from the soft blue, too soft for aught, save springs, perhaps, by varying degrees of hardness through purple and shades of orange and yellow to the flinty gray of hardness, all the colors are at hand and may be tested with a file and the one selected to suit the need.

One thing is especially to be remembered. Never heat the steel hotter than is absolutely necessary to get the requisite temper. Excessive heat is ruinous to steel. If it is not burned in the operation, it opens the grains and no process of merely hardening it will refine it so as to be as valuable as before. So by testing a piece and afterward using that particular brand of steel, a novice will soon become quite an expert and reliable.

A New Aluminum Process.

A private exhibition to a few interested capitalists was given recently of the new process for making aluminum invented by Col. William Frishmuth, at the laboratory of the Enterprise Aluminum Co., Rush and Amber streets. The process is partly chemical and partly electrical, the aluminum oxide being extracted from pure clay and dissolved. The solution is then exposed to the electric current, which causes the pure metal to be thrown down on brass plates. From this it is removed by an ingenious but very simple chemical process in a state of almost perfect purity and in the form of a silvery impalpable powder. It only remains to smelt it into ingots. Col. Frishmuth estimates that the aluminum can be extracted at a price far below its present market value and in any desired quantity. But a singular circumstance connected with it is that the by-product or residue from the chemical treatment of the clay possesses high value as a fertilizer, and this, it is claimed, will be sufficient to pay all the expenses of the operation. An analysis of the by-product, made by an expert chemist without knowledge of how it was produced, was submitted. He estimated its value as a fertilizer at from $8 to $10 per ton.

A charter has been procured and a company formed which will immediately proceed to manufacture the metal commercially. It is designed to operate the first plant in this city for a time, the clay being brought here from New Jersey, where a bed free from deleterious substances is found. The promoters are so confident of success that they think that in a short time the profits will enable them to put up extensive works in the immediate vicinity of the beds.—[Philadelphia Ledger.

Qualities of the Heart.

Errors can be forgiven if the heart is all right. No service is so genuine and valuable as that of the heart. The hands and head may perform it in a desultory manner, but that done by the heart is of a different sort. This may be sometimes applied to inanimate as well as animate things. For instance, an article with the declaration, "My heart is at your service" on it, has recently been brought out by The Joseph Dixon Crucible Co. of Jersey City, N. J. This Shakespearean expression is very appropriate as coming from this article, for it is a lead pencil.

MANY of the writers in the SCIENTIFIC MACHINIST have dwelt upon the importance of a good grindstone. It may not be uninteresting to readers to know that the catalogue of the Cleveland Stone Co., is very complete on grindstones. It has illustrations of every kind and is a valuable work. Their address is 36 Wilshire Building, Cleveland, O.

One of the staff editors of the SCIENTIFIC MACHINIST has a lathe made by the W. F. & John Barnes Co., of Rockford, Ill., in his experimenting room, and is much pleased with it. The machine is well finished, is reliable, easy running and in every respect a very fine tool.

STRUCTURE OF THE STEAM-ENGINE.—II.

BY PROF. R. H. THURSTON.

Corliss Engines.

The mill or factory engine of latest date is very generally horizontal, direct-acting, with a detachable expansion valve, a governor operating by adjusting the point of detachment and closing of the valve; which latter is closed quickly either by gravity or by a spring, or, sometimes, by steam pressure. In a few instances, engines have been built in which the valve continuously rotates, closing without reciprocation. When of small size, the stationary is made non-condensing; when of large power, it is very frequently a condensing engine. When large and where economy is very essential, it is frequently a "compound" and often a "triple-expansion," engine; the steam-pressure being carried higher as a higher ratio of expansion is adopted. In many cases, as in cotton-mills making fine grades of product, or for electric-lighting, precise regulation of speed is required, and this may determine the choice of type of engine.

The best known engine of this class is the Corliss engine. It is very extensively used in the United States, and has been copied very generally by European builders. Fig. 32 represents the Corliss engine. The horizontal steam-cylinder is bolted firmly to the end of the frame, which is so formed as to transmit the strain to the main journal with the greatest directness. The frame carries the guides for the cross-head, which are both in the same vertical plane. The valves are four in number, a steam and an exhaust-valve being placed at each end of the steam cylinder. Short steam-passages are thus secured, and this diminution of clearance is a source of some economy. Both sets of valves are driven by an eccentric operating a disk or wrist-plate, E (Fig. 33), which vibrates on a pin projecting from the cylinder. Short links reaching from this wrist-plate to the several valves, D D, F F, move them with a peculiarly varying motion, opening and closing them rapidly, and moving them quite slowly when the port is either nearly open or almost closed. This effect is ingeniously secured by so placing the pins on the wrist-plate that their line of motion becomes nearly transverse to the direction of the valve-links when the limit of movement is approached. The links connecting the wrist-plate with the arms moving the steam-valves have catches at their extremities, which are disengaged by coming in contact, as the arm swings around with the valve-stem, with a cam adjusted by the governor. This adjustment permits very perfect regulation by automatic variation of the ratio of expansion by the governor.

The standard form of Corliss valve is very well exhibited by the illustrations here given, which are taken from the drawings of Mr. Harris.

Those marked A are the steam, and those marked B are the exhaust-valves. Both consist, as is seen, of cylinders, parts of which have been cut away, leaving the working and bearing surfaces of no greater extent than is necessary to subserve the purposes of the valve. These surfaces are of the simplest possible form and are easily fitted up in the lathe. In order that they may come to a bearing with certainty, and without regard to the position of the spindle relatively to the valve, they are made with a longitudinal slit into which fits, without jamming, the blade of the rock-shaft. The valves are thus allowed to come to a bearing, and even to wear down in their seats without causing leakage.

The next figure shows the arrangement of this valve as seen in longitudinal section of the chest. As this maker constructs it, the stem goes through a fitted opening, without stuffing-box, and the slight drip is carried off from the closed space at D, thus none escapes into the engine-room. The steel collar at F, which is shrunk on the stem, fits into the recess at *a* and serves as a packing. As the tendency of the stem to shift outward always causes the collar to wear to a fit, it is not likely often to wear leaky.

Another detail of interest in the Corliss engine is the "dash-pot." When the valve is suddenly closed, some device is necessary to prevent jar at the instant of its coming to rest. This device is the dashpot. The form adopted by Corliss consists of a shallow cup into which a piston on the valve-stem fits, cushioning the enclosed air, and thus checking the motion of the valve without shock. This dash-pot, made by Watts, Campbell & Co., who have successfully introduced Corliss engines into electric-light establishments in New York City and elsewhere, is that seen in the figures.

The annular piston, E, E, fits the cylinder, D, D, E, E, and a space, seen above B, forms a vacuum-chamber which assists the spring or weight, closing the valve by the formation of a more or less complete vacuum, as the piston is raised while the valve is opening. A small cock, not seen, is arranged to adjust the degree of exhaustion of this chamber. When the valve has nearly reached its seat, the piston, D, passes the opening from F into the outer space and the enclosed air then acts as a cushion, checking the movement of the valve.

The "dash-pot" was invented originally by F. E. Sickels. In the original water dash-pot of Sickels, the cylinder is vertical, and the plunger or piston descends upon a small body of water confined in the base of the dash-pot. Corliss's air dash-pot is now often set horizontally.

The Corliss engine is the prototype of a large number of engines constructed in Europe and America, having the same or very similar structure and methods of operation.

The leading features of this machine are thus:

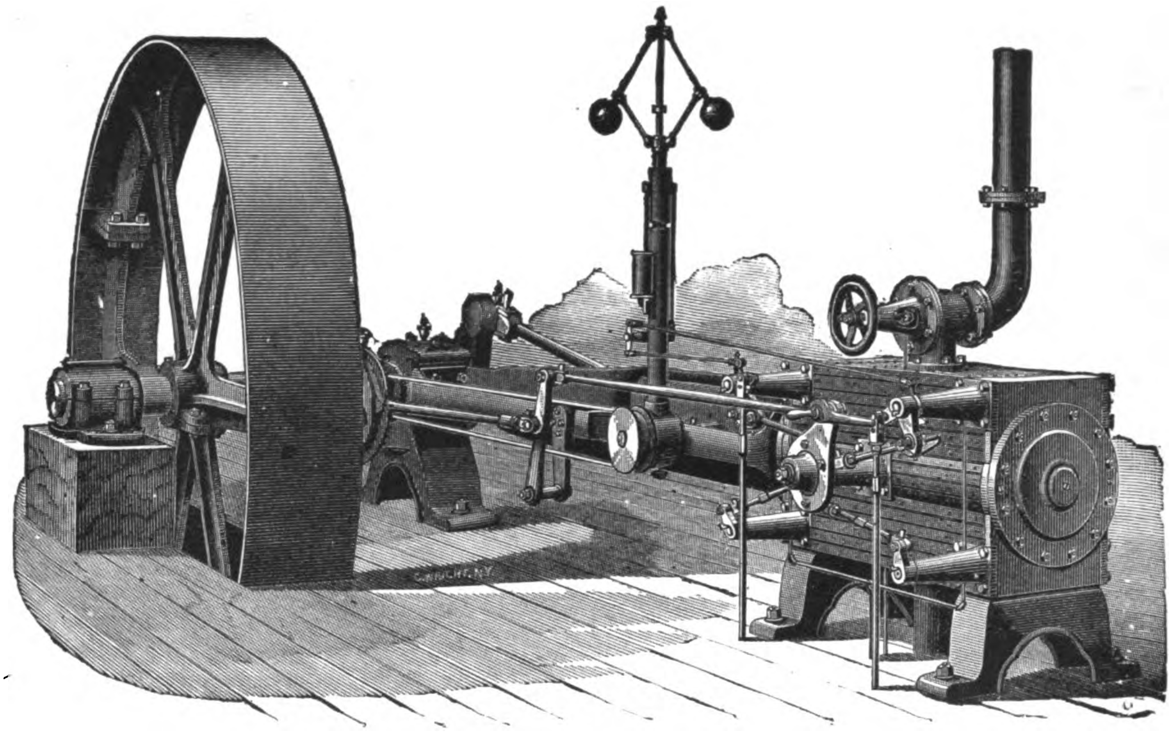


FIG. 32.—CORLISS ENGINE.

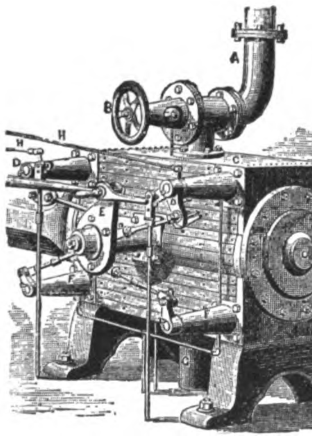


FIG. 33.—CORLISS ENGINE, VALVE MOTION.

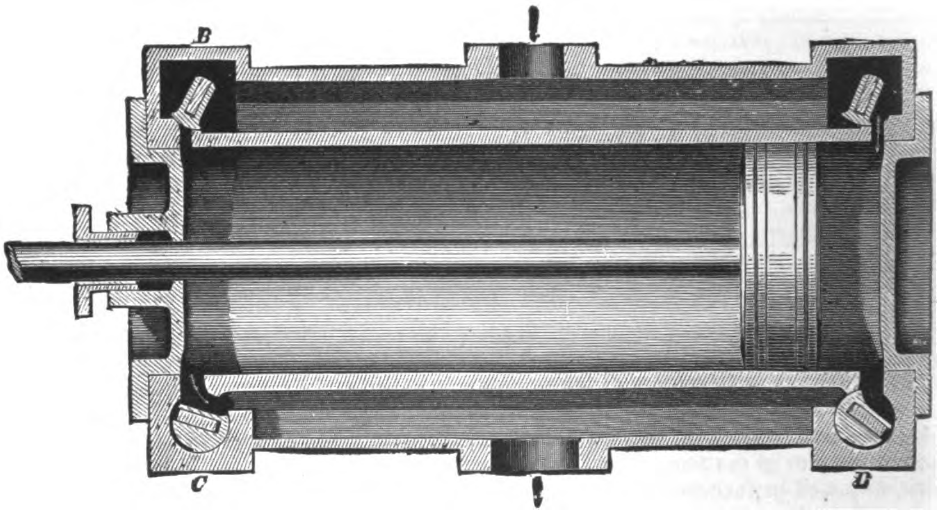


FIG. 34.—THE CORLISS ENGINE CYLINDER.

(1) The use of four valves—two steam and two exhaust—so placed as to reduce "clearance" to a minimum.

(2) The use of rotating valve, capable of being cheaply and readily fitted up, of being easily moved, and of being conveniently worked by connections outside the steam-spaces.

(3) The use of a "wrist-plate," caused to oscillate by a single eccentric, and directly so connected with all four valves that each may be given a rapid opening and closing movement, and to be held open and nearly still, at either end of its range, by swinging the line of connection nearly into the line between centres, thus permitting nearly a full opening of port to be maintained during an appreciable interval, and a free and complete steam supply and exhaust.

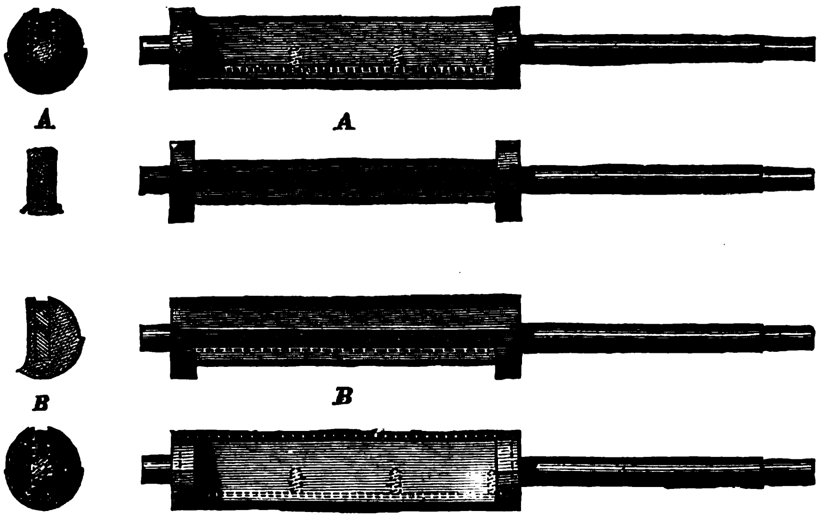


FIG. 35.—HARRIS CORLISS VALVES.

(4) A beautifully simple and effective method of detaching the steam-valve from the driving mechanism, and of insuring its rapid and certain closure at the proper moment, to produce any desired expansion of steam.

(5) A direct connection of the governor, so as to determine the ratio of expansion, while so adjusting the power of the engine to the work to be done that the variation of speed with changing loads becomes a minimum.

(6) Making this latter adjustment in such a way as to throw the least possible work on the regulating mechanism, and thus to give the governor the greatest possible sensitiveness and accuracy of action.

(7) A form of frame and general design of engine which gives maximum strength and stiffness, with least cost and weight.

All these features are combined to form a steam-engine essentially different, in general and in detail, from all earlier engines. In operation, the engine was found to exhibit a remarkable economy of fuel, and a singularly perfect regulation, and to be far more durable and more economical in cost of repairs, on the average, than was generally supposed possible.—[From "A Manual of the Steam-Engine," by Prof. R. H. Thurston; John Wiley & Sons, 53 E. 10th St., New York.

(To be continued.)

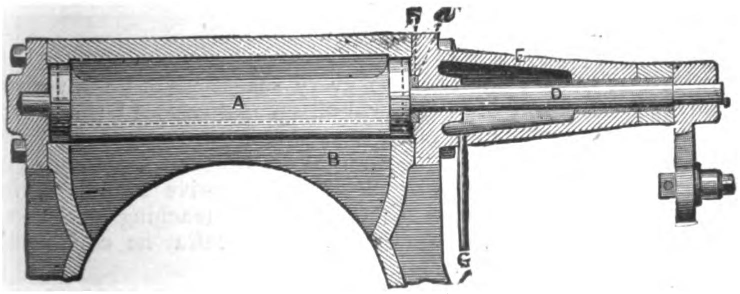


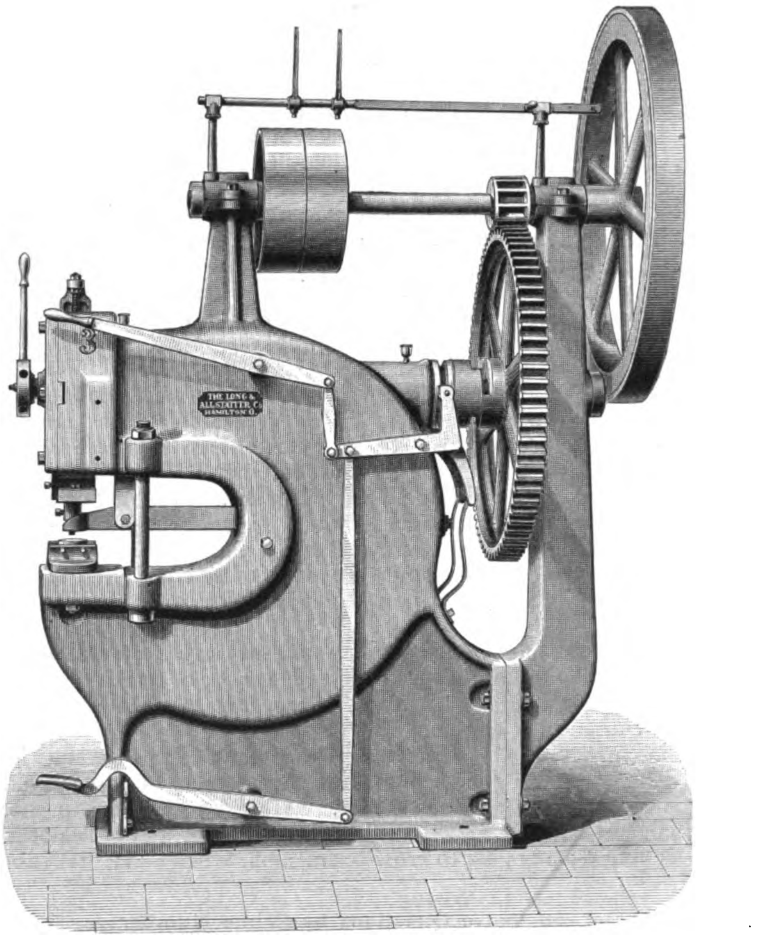
FIG. 36.—HARRIS CORLISS VALVE.

PUNCHING AND SHEARING MACHINE.

The machine shown in our illustration is one of the latest productions of the Long & Allstatter Co., of Hamilton, O., and is designed for general punching and shearing, boiler work, etc. The system of construction follows very closely that generally adopted by the above company in their machines of this general class. But in the present design the amount of room occupied by the machine has been very much lessened, the usual rearward projection of the tight and loose pulley being entirely avoided by placing them over the machine. This compactness of the machine will be greatly appreciated in many situations. The particular size of machine shown in our illustration is adapted to punch a seven-eighth inch hole through seven-eighth inch plate, and to shear three-quarter inch plate, and operate twenty-four inches from the edge of the plate, that being the depth of the throat, and of course the machine is adapted for doing any work requiring less capacity. The throat is provided with removable tie-bolts, and when these bolts are inserted, then the machine is of course very much strengthened and fitted for very heavy work.

The slide is operated by steel cam-shaft operating through steel pendulum with gun metal bushes, and the cam-shaft may be turned by hand to facilitate the setting of the tools. The hold-down or stripper is of very efficient construction and is so arranged as to be quickly removed.

The illustration shows a machine of the size and capacity which has been above indicated, but the builders also construct machines of this design in quite a number of other sizes, arranged to be driven either by belt, or by self-contained steam engine attached directly to the machine. The makers will at all times be glad to furnish full information regarding any of these machines upon receipt of inquiry.


THE LONG & ALLSTATTER CO. HAMILTON, O.

You Can Now Blow Out the Gas.

A western genius has devised an arrangement for preventing accidents by the careless use of gas. On the inside of each burner is a valve attached to a silver wire, which protrudes about one third of an inch above the burner. In order to light the gas all that is necessary is to bring the match in contact with the silver wire. This expands and opens the valve by which the gas is admitted into the burner. Silver is one of the conductors of heat, and it does not take more than five seconds to light a jet. Blow out the flame and ten seconds later there is no odor of escaping gas perceptible from the self-closing burner.—[Cleveland World.

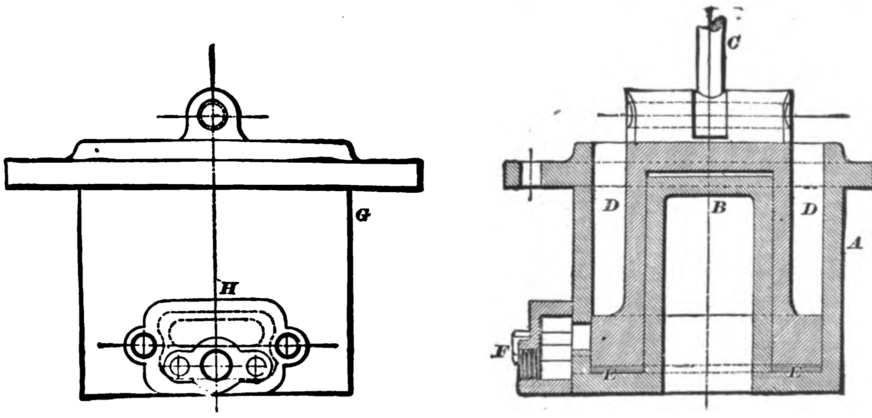


FIG. 37.—THE DASH-POT.

THE LODGE & DAVIS MACHINE TOOL Co. works at Cincinnati, O., have just contracted to furnish a large equipment of their improved lathes, Plainers, drill presses, etc., to the Georgia School of Technology shops, at Atlanta, Ga., which recently burned out.

FOR a catalogue of lathes and drill presses, showing many sizes in light and medium tools, write to W. F. & John Barnes Co., 920 Ruby street, Rockford, Ill.

Rare Opportunities.

The Queen & Crescent Route will place Excursion Tickets on sale to Texas and Arkansas, also Indian Territory, at greatly reduced rates, on August 30, September 27th, and October 25th. Good for return 20 days from date of sale. For rates, maps and further information, call on Agents of the Q. & C. Route, or agent at your station, or address D. G. Edwards, G. P. A., Cincinnati, O.

Hunting Season Opened.

For special rates to hunting territory, call upon Agents of the Nickel Plate.

Practical Letters.

About Cut-Off and Other Matters.

EDITOR SCIENTIFIC MACHINIST:

I don't know that it is right to dwell any longer on this boiler and engine question. In my opinion it is not worth the space devoted to it in the paper, and Mr. Wilcox's answer will add to the general confusion, which prevailed throughout the discussion, if you can call it such.

But I possitively called to have "something to say." I first refer to Mr. Wilcox's valve setting. Like Mr. J., I have a common slide-valve engine. He proceeds to cut off at ¼ or ⅓ stroke. How he'll accomplish that with a common slide-valve engine (reducing valve-travel or making new eccentrics of course excepted), would be an interesting piece of engineering.

Now the way I understand Mr. Joels is, he has a slide-valve engine with a Stevens, or similar valve. The rocker arm which connects with eccentric-rod is slotted to permit a limited reduction or increase of valve-travel; say ⅝ to full stroke. It is impossible in this case to say, (not knowing the load) when cut-off should take place. But one thing is certain—it cannot occur earlier than ⅝ of stroke. (To anybody who wants to know all about the slide valve, I would recommend "Slide-Valves" by J. Rose, published by H. Carey, Baird & Co., Philadelphia). Besides this the style and action of the governor are to be considered as well as the boiler pressure. Eighty-five pounds might be throttled down to 40 pounds or less.

To speak broadly, the load for such an engine should be so that we can cut off at about 0.63 of stroke, release at 0.93 of stroke, compress 0.07 of stroke, with lead from $\frac{1}{64}$″ to $\frac{1}{16}$″ according to clearance, speed and balanced condition of engine.

Something I don't understand is the terrible pressure on Mr. Joels valve. I wonder if a good refiting and then proper lubrication didn't end the trouble. But the question comes, "How are we going to know when small boiler is doing this?" Weigh your feedwater and put calorimeters in pipes leading from boilers to cross connection. H. HEYRODT.

To Prove Questions by Prime Numbers.

EDITOR SCIENTIFIC MACHINIST:

In your issue of the 15th there is an article by Jearum Atkins on casting out the nines and proving questions in arithmetic. I have known all he has written in that article for at least twenty years.

I inclose a few examples of proving questions by another method, which I think is simpler than casting out the nines; also two examples of tricks with the figure nine as a basis.

In proving questions by this method all lines of figures have to be brought to a prime figure; that is, added until only one figure remains, which is the prime figure. Take as an example the line of figures 48,768, which added together are 33, which added again, 3+3=6, which is the prime number.

To prove a question in addition, get the prime figure for each line and add them; if correct both prime figures will be the same. Example:

```
 4,876=25=7
 3,942=   9
 6,854=   5
 3,236=   5
 ------   --
18,908=  26=8
```

In subtraction, the sum of the prime figures of the subtrahend and remainder should be the same as the prime figure of the minuend. Example:

```
84,625=25=7
64,534=22=4
------    -
20,091=12=3
```

In multiplication, the prime figure of the multiplicand, multiplied by the prime figure of the multiplier gives the prime figure of the product. Example:

```
  5,846= 5
     34= 7
  -----  -
 23,384  35=8
 17,538
-------
198,764=    8
```

In division get the prime figure of the dividend, which in the following example is 7; then get the prime figure of the quotient, which is 2; multiplied by 1, the prime figure of the divisor gives 2+5 (the prime figure of the remainder), gives 7, the same as prime figure of the dividend. Example:

```
19)8764(461=2×1=2+5=7
   76
   --
   116
   114
   ---
     24
     19
     --
      5
```

To prove square root by the above method is simple and can be proven at any stage of the question by getting the prime numbers of the figures used. In the example, the prime figure for 552 is 3, the prime figure for the root 23 is 5, which, squared, is 5×5=25=7, to which add 5, the prime number of remainder; 7+5=12=3, the same as prime figure of 552, which proves the question right so far.

```
    55248(23=5×5=25=7+5=12=3
    4
   ----
43 | 152
   | 129
   | ---
   |  23=5
```

To prove cube root, proceed as in square root, only cubing the prime number instead of squaring it.

MYSTIC NUMBER NINE.

The prime figure of any number multipied by nine is always nine, no matter how often it is multiplied by any other number or numbers, the prime figure is always nine.

Any person who knows this rule, can amuse a company, by asking one of them to put down three or four or any number of figures, then tell him to multiply by 9, then by 4 as in example, but any other figure will do as well. Then let him multiply by any figure he chooses, say 7; after he has finished, ask him to rub out any figure in the answer, and tell you what he has left. Say he rubs out 7, he tells you he has 9,236 left. You add this mentally and find the sum is 20. The prime figure being 2, you then know he must have rubbed out 7, as 2+7=9, the prime figure you should have got. When you tell the company it was 7 that was rubbed out, they will not think it was so simple a matter to find the figure. Suppose a 9 or 0 had been rubbed out, of course you do not know which, but it is always safe to say nothing first, as if there is a 0 in the answer, it is oftener rubbed out than 9. Example:

```
   368
     9
------
 3,312=9
     4
------
13,248=9
     7
------
92,736=9
```

Another: Ask anyone in the company to put down a line of figures, then add them, and substract the sum from them; then ask him to rub out any figure in the answer he chooses, and tell you the remainder, say he rubs out 4, he tells you he has 1,841 left, add them mentally, which you find to be 14=5 (prime figure). It requires 4 to make 9, therefore he rubbed out 4.

```
18,462
    21
------
18,441
```

In this example the operator does not know a figure that was put down. The rule for the above is, when the sum of any given number of figures is subtracted from those figures, the prime number of the remainder is always nine. N. HAMPTON.

A Suggestion.

EDITOR SCIENTIFIC MACHINIST:

Knowing that you are interested in every suggestion or improvement that can be made in the way of mechanical pursuits, therefore I would suggest to you, as there are a great many young men throughout the South who would like to take lessons in mechanical drawing and are not able to go a long distance from home, or to the more expensive schools of the North, that if some competent man who is capable of teaching mechanical drawing and engineering, would come here, I believe that he could build up a good school in a short time.

If you have no objection to making a note of this in your paper, will say I would be pleased to correspond with anyone who would like to get further information on the subject, and cheerfully give him any assistance I can. Should be glad to hear from you regarding same, if not troubling you too much. I have no special personal interest in this matter, but think it would be of a great benefit to many of our young men who are anxious to improve themselves, but have not the means or opportunity. And as Winston-Salem is one of the most progressive towns in the South, and fast becoming the principal railroad center between Richmond and Atlanta, would suggest, this would be an excellent opening for some man to start up such a school. Winter is approaching, and I would suggest that now would be the time to begin. Yours truly, C. A. HEGE, Salem, N. C.

DESCRIPTION OF STRONG'S VERTICAL TRIPLE EXPANSION ENGINE.

(Continued from first page.)

is independently balanced by a counter weight on the crank, less foundation is required, and more quiet running produced than would otherwise be the case. This is very important in buildings where jars from engines are very annoying. If it is desired that the engine shall be absolutely noiseless, it can be placed upon a foundation insulated on the bottom by cork from the foundations of the building, while on the sides packing or other material can be used that will not transmit noise nor vibrations to the walls.

To meet the requirements of an engine using steam of 180 to 200 lbs. pressure, piston valves have been selected for the high, and intermediate cylinders, and grid-iron slide valves for the low pressure cylinders. By this means frictionless valves for the high and intermediate cylinders, where the pressure is high, are secured. In those cylinders the matter of clearance is comparatively unimportant. In the low pressure cylinders, however, small clearances are very necessary for economy, and are brought about by the use of the grid-iron valves in the cylinder heads.

The piston valve of the high pressure cylinder is actuated by a block sliding in the well known Fink link, so designed as to give a perfectly equal lap and lead, and at the same time equal cut-offs at both ends of the cylinder. The position of this block, and therefore the cut-off, is controlled by a sensitive high-speed governor, the resistance to the movement of which is very slight. The exhaust of the high pressure cylinder, and the admission and exhaust of the intermediate cylinder, are controlled by a connection to a fixed point at one end of the link. These valves have a fixed travel, and point of cut-off. The movements of the low pressure valves, both inlet and exhaust, are produced by the same connection of the Fink link, and are such that when these valves are unbalanced they are motionless.

All pins and bushings in the valve gear are of hardened steel, thus reducing the wear, and rendering replacement easy.

The governor is provided with a safety device, so arranged that in case the governor belt breaks, the arms of the governor will be elevated and the link block thrown to an extreme position, thus cutting off the supply of steam and bringing the engine to a stop.

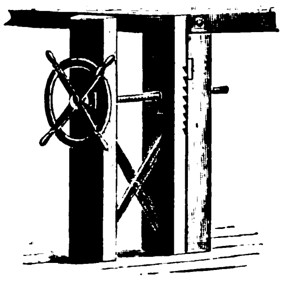
The crank shaft is forged from a solid steel ingot, and the counter weight is bolted on. The pedestals are bored and turned on their bases to fit a bored seat in the bed plate or frame of the engine, to which they are secured by ream bolts. The seats for these pedestals are bored by a single setting of a boring bar, and are consequently in perfect alignment.

There are two sizes of this engine made, one being of 150 indicated horse power, and the other of 250 indicated horse power. The first runs at a speed of 300 revolutions per minute, and the second at 225. It is the intention of the builders to manufacture these engines in sizes up to 2,500 horse power.

The engine described is the invention of George S. Strong, of 45 Broadway, New York, and is manufactured by the Providence Steam Engine Co., who build the well known, and excellent, Greene automatic and cut-off engine. This company believes that it is filling a long felt need for an economical high speed, and high class steam engine. The details of the engine have been worked out under the supervision of F. W. Dean, in his office, at 53 State street, Boston, Mass.

THE PARALLEL VISE.

The accompanying cut represents a new vise which has been named "The parallel," because of the parallel or equal movement of the upper and lower end of its jaws. Among its advantages may be mentioned simplicity, evenness of grip, reliability and accuracy of movement, convenience of its wheel handle, which also adds to the ease of management, and its capacity of being raised or lowered instantly to any position suitable to the work. The parallel is produced by a compound cross lever, evenly balanced at the center and riveted. The upper end of one lever is stationary on the inner jaw, the upper end of the other lever is stationary on the outer jaw. The lower end of each lever moves in a grove in each jaw. The vise is raised or lowered to position by means of a ratchet block back of the inner jaw, which drops into its notch as the vise is elevated, and which is secured by the pressure of the screw. In lowering, the block is simply thrown back to a vertical position by a mere touch of the hand. Further description can be furnished by the manufacturers, McCullum & Butcher, 40½ South Water street, Cleveland, O.



THE PARALLEL VISE.

THE USE AND ABUSE OF SMALL SAWS.

No wood-working plant can be equipped without a variety of small rip and cut-off saws. Of these tools more is required than of any other, and their extreme sensitiveness divulges many influences. The source of all trouble comes from a dull and improperly filed saw. There is no reason, thinks the *American Exporter*, why a small bench saw should not be worn out without hammering or straightening, but in the best regulated shops the saw suffers considerable abuse. While a small saw is a small tool, there is no fixed, that is, adopted rule for filing and setting it. All saws for ripping should be swaged a little when the space of the teeth will allow it. This is universally ridiculed because not adopted. The teeth of all saws tend to wear narrower at the point, and when teeth get into this condition the saw cannot do nice work. More set does not alleviate the matter. There is a way of getting along without swaging in some cases, which requires the following to keep the outer corner sharp:

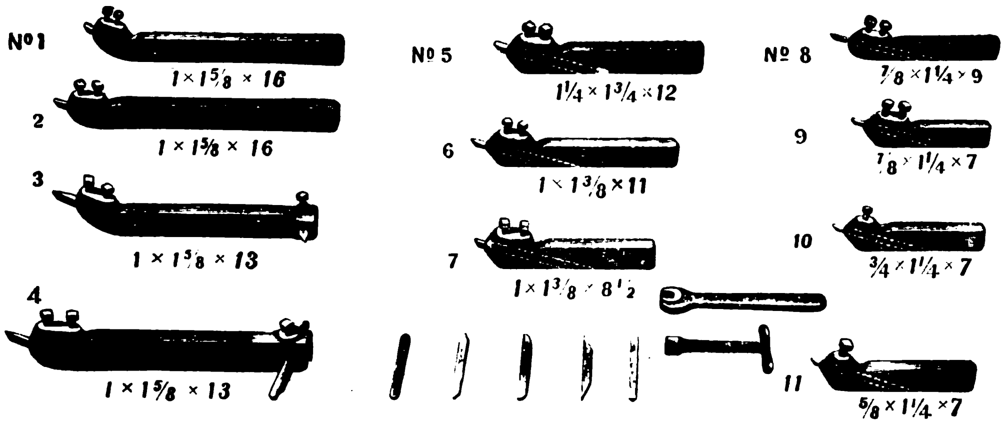
Frequent heavy jointing, with more filing on the front of the teeth than necessary and setting at each filing. The result is more work and waste of saw-plate by not swaging a little. A saw that requires swaging can be swaged and the set gauged with but little bent set, and as the swage wears off the teeth are bent a trifle to give the required set, which is not much, as a sharp corner will cut cleaner and freer than a shoulder on a tooth. Teeth that are bent for set and are not frequently jointed, will leave a core; that is, each tooth will not cut half of the kerf, which is a great resistance on a saw. Only in very thin saws is this liable, but in any size rip-saw up to a log-saw the teeth will wear to a shoulder and require fifty per cent. more power to pull it. That the swaging of small saws be more fully understood, it is not intended that the points should be bitted out as some men term swaging, but the points kept a trifle wider than the gauge of the saw.

Saws should be filed more often, so that the condition of the saw be as near normal as possible, and so that the sawyer can become familiar with the running of a saw or saws. There is a certain amount of familiarity or symmetrical work necessary to accomplish fine and rapid work with a saw. When a saw fails to obey it has broken some of its familiar traits, caused by bad filing, being dull, and often forced until the plate is bent, blistered or its tension gone. All may be cited to a dull saw, the operator not being familiar with such manœuvers as the saw assumes, viz., crowding out or into its work, snaking, running with a quiver or tremble, the edge assuming a width twice the thickness of the saw. In a few seconds the saw cools off, assuming a steady position, unless it has been buckled, which is more than likely. A saw kept round and in nice shape, will cut free, smooth, fast and straight. In planing mills and factories where much re-sawing is done there is much made in the use of as thin a saw as possible—where several cuts are to be made in ripping up stuff the amount of dust removed is quite an item. Thin saws and small diameter, should be kept in good order.

It will pay any man interested in such saws to become familiar with their requirements in keeping them up. They should be gummed a little and often and sharpened often. Saws, to do fine, fast work, must be kept in a neutral condition; when the fence is not kept right, the saw will soon become dished and will be a continual annoyance by crowding from its work. The fence or gauge should be set a trifle nearer the cutting side of the saw. In lining a saw, care should be exercised to have the belt on to hold the mandrel in its running position in its bearings. End motion must be guarded against if fine work is necessary. A saw will cut much, either ripping or cutting off, if only the top of the saw cuts. In fast feeding there are not the broken chips at the bottom of the board. A sharp saw cutting near the center will do nice work and cut straighter. The saw pulley should be kept clean and free from dust which will accumulate and throw the mandrel out of balance. This is a point overlooked by many. It causes the journals to heat and wear very fast, which brings on trouble with the saw.

EBERHARDT'S TOOL HOLDER.

After trying in their works most of the different makes of tool holders, Gould & Eberhardt, of Newark, N. J., devised the ones shown in the accompanying engraving for their own use. These are claimed to possess all the good points of the others and to avoid their objections. It will be observed that the holders are made with straight bodies or with their ends bent either to the right or left. Extending backward and downward from the end is an opening intended to receive the cutter. This opening is at such an angle with the main portion of the holder as to yield the best results in general work, and as it is never necessary to grind the upper surface of the cutter this angle is always maintained. Some of the holders are provided with a transverse opening in the rear end. The holders are made of cast steel and the set screws of hardened tool steel.



EBERHARDT'S PATENT TOOL HOLDER

Among the advantages claimed for this tool are that the cutter never requires forging, and consequently the variation and annoyance caused by a tool being "too hard" or "too soft" or "burnt" are entirely avoided, leaving the quality of the steel in the best possible condition—viz., as it comes from the mill. Any desired form or shape can be ground in a short time, there being but a small surface presented to be ground. Each holder is provided with five pieces of special self-hardening steel, each end ground to a different shape. Concerning the cutters, the makers say: "For finishing tool steel a water-hardened and tempered steel will be found to give best results, as we have been unable to secure a self-hardening steel, up to the present time, that would withstand this duty for accurate work. We will furnish, when so ordered, tempered steel of the same size as self-hardening to fit the holders and to be used for finishing tool steel." The self-hardening tools are ground on a dry wheel only, sufficient pressure being applied to make the steel red hot if necessary, but it must be allowed to cool off naturally in the air.

METAL-CUTTING TOOLS.—I.

The average journeyman machinist, as a rule, is not much given to philosophizing on the whys and wherefores of commonly-accepted shop practice. If a good hand, skillful and careful in the performance of his work, he knows the proper methods, for the different opperations, and follows them. He knows, for instance, that a certain form of tool, as to shape and temper, is correct to use for a given purpose. It does the work properly, and is sanctioned by custom; therefore it does not occur to him to question its propriety, nor to theorize as to the reasons for its peculiarities. This is by no means a disparagement of his intelligence or knowledge of his trade. It is simply due to the fact that he was taught to use it when learning his trade, usually at an age when deep thinking is not the rule, and from constant use, he becomes so familiarized with it that it is regarded as a simple matter of fact, and not a subject for study. Nevertheless, a knowledge of the theoretical phase of the matter must have been possessed by somebody, otherwise the tool could hardly have been devised. Who is so proper a one to originate a device as he whose business it is to use it?

Metal-cutting tools used by machinists are peculiar in that many of them are made by the workmen themselves, or at least under their personal direction, for the reason that there are so many modifications in small details of form and so nice a range of tempers necessary to render them suitable for the work, that it would be impossible to adopt any standard which would meet all requirements.

The essential qualities of a metal-cutting tool are, broadly, the proper form of edge and backing to enable it to cut cleanly and with the least possible friction, and a temper as hard as the nature of the strains to which it is subjected will allow. Lathe and planer tools have substantially the same operations to perform—subject, of course, to some modifications—though the cut in the former is rotative and continuous, while in the latter it is rectilinear and consequently reciprocating. Of course, there are many operations on either machine which are not common to both, but these are merely modifications of the general principles. The tools used for the simpler operations on both machines may be considered together and the modifications to adapt them to each can be noted as we progress.

First, then, we wish to turn a wrought-iron shaft, upon which the character of the work requires the use of a large variety of tools. The first operation after centering should be squaring up the ends. This, in an ordinary engine lathe, having the poppet head toward the right-hand end of the bed, will require the use of a right-hand side tool, which, while one of the most used, is also one of the most improperly used. The requirements readily suggest its form. It should be knife-shaped, broad and flat, having the line of edge parallel, or nearly so, with the bar or body of the tool, which is set at a right angle with axis of the shaft. The angle of bevel should be about 45°, and that of face, or left-hand surface next the work, just sufficient to afford clearance. If too great, the tendency of the tool is to dig into the metal, and as there is always more or less spring or lost motion in the rest and carriage of the lathe, this tendency is pretty sure to materialize, the result being a gash in end of shaft, which may or may not turn out, and probably a broken tool or center. The angle of point should be such as to insure its reaching close into center of the work without touching the dead center. As the standard center gauge is 60°, one-half of which is on each side of the axis, there will be 60° from which to deduct the clearance, which, if say 5°, will make angle of tool point 55°. In setting the tool, its point should come as nearly at hight of center as possible.

There are two methods of using the side tool, a light cut and quick feed, and a heavy cut and slow feed; either will do good, clean work in roughing, but for the last, or finishing cut, which should give a clean, bright surface, a very light skim cut, with moderately high speed and slow feed, will be best. When there is considerable stock to be removed in squaring up, a very desirable modification of the tool may be made by grinding or bending the point (for a lathe of say 20" swing) so as to give an edge about 5-16" long from point, set at an angle of about 30° from line of tool. In setting, this edge should be parallel with line of motion of the rest, thus throwing the main edge and body of tool around to right at corresponding angle. By this method the tool may be run into center and fed (by hand feed) longitudinally, as far as necessary to remove all the stock except the light skim necessary for finishing cut. This forms the roughing cut, and the tool is then fed outward from center slowly, leaving a clean, true surface and preesrving the parallel edge for the finishing cut. The latter should also be fed from center outward. Where there are a number of ends to be squared up, a tool of this form will be found much more durable and convenient, as well as quicker working, than the ordinary straight-edge form.

The left-hand side tool, used for crosscuts on left-hand shoulders, collars, etc., should be made in all respects the same, except that it is reversed. The bent side tool is used for work in which it is necessary to reach beyond the line of rest—as, for instance, in chucking or truing up face plate, when the carriage would strike the work unless the tool were overhung. This modification applies to both right and left hands, and is made by bending the entire blade or edge of the tool at an angle of from 30° to 45° with the body. The points in which the side tool is most commonly misused are less numerous than important, and are generally the result of carelessness in grinding. The point of tool will not clear the dead center; or there will be too much or too little clearance to face; the bevel will be too great or too little—all of these faults will cause bad work and waste of time also. The proper temper, by color (drawing from full hardness only), should be a dark straw color. If made harder it will cause much annoyance from the continual breaking of the sharp point necessary to reach the center. The cutting edge, also, is too thin to admit of its being full hardness. The side tool, with all of its modifications as used on the lathe, may be used on the planer without any changes being absolutely necessary.

Where the tool is made for planer use exclusively, however, the point may be of stronger form, as it is only necessary to give it an angle of clearance of 1° or 2° with line of motion of planer bed. The practice of feeding the side tool (whether on lathe or planer) with the point leading is improper, as it not only dulls the point and prevents clean cutting, but is contrary to the principles of operation for which the tool was designed. For squaring and chamfering nuts a very convenient form of side tool is one having the main edge set as for ordinary side cutting, and the chamfering edge bent at the desired angle, either at heel or point of main edge, according to the kind of nut mandrel used. If the latter is of the form used to run on the lathe centers the chamfer cut should be on point of tool, but with the most convenient style of mandrel—that which fits into center socket of live spindle—The chamfering may be done at heel or point, as desired. The advantage of the former is that it can be readily sharpened on the grindstone, while the latter must be done either on a true-faced emery wheel or by annealing and filing.

The diamond-point tool is used for turning longitudinally, and is almost invariably fed by the power feed of lathe. Its shape and method of setting, it is safe to say, are more often wrong than right, as will be readily seen by comparing the correct principles of metal cutting with the practice so common, even among good lathe hands. For some occult reason, the faults in the use of this tool on the lathe are not observable on the planer. Strange as it may appear, the same workman will dress, grind and set his diamond-point tool on the planer in a manner perfectly correct; while on the lathe it is very nearly as wrong as possible. And yet the same general principles apply in either case. The fact that one surface is flat and the other cylindrical does not necessarily involve any radical difference, as might be supposed from the wide difference in the usual forms of the two tools. In reality, a correctly made diamond-point planer tool may be used with equal facility for lathe work, though to say that the ordinary lathe tool can be made to do duty for planing would be manifestly absurd.

There is one fundamental principle to a misconception of which this distortion of form of the diamond point is due, and its incorrect use is the natural sequence. For planer use the clearance back of point is made as it should be; that is, only sufficient to avoid touching back of the cut. The angle of diamond face, from which the tool takes its name, inclines well back from point, and also from the cutting edge on side. The cut is clean and smooth, and the chip long, curled and tough, on wrought iron and steel, and even a fairly good quality of cast iron will curl over two or three times before breaking off. The motion of planer bed under the cut is steady and quiet, while where an improperly made tool is used even the best of planers will have a motion which is jerky and irregular, with more or less rattle of the gearing. The chips will be short and brittle, and nearly straight, while the surface of the work, under both point and side edge, will be more or less rough, as the metal is not really cut, but pushed or torn off by main strength.

For lathe work the idea seems to be that by elevating the tool point well above line of centers the best cutting effect will be produced; and so exaggerated has the idea become that it is not unusual to see the point of tool thrown over to an angle of 45° or more. Now, in order to obtain the same cutting action in the lathe as is usual on planer work, the clearance must be considered in relation to a line tangent to the periphery of the cylindrical surface of work at bottom of cut. Therefore, if a clearance of, say 1° from line of planer bed be correct, its equivalent for the lathe would be 1° from the vertical tangent. It is readily apparent that a theoretically correct tool would be so made and set, as the strain of cut will then be perpendicular to the lathe bed and rest, and will have no effect whatever on the working parts of the latter, nor upon the carriage, except its bearing on the ways, which being made to support such strain, do not suffer. On the other hand, the tool as commonly used, being set to clear a tangent of from 30° to 45° from the vertical, must cause a corresponding proportion of the strain of cut to be thrown against the feed screw of rest, and both thread and collar are thus subjected to wear and tear, which will soon cause an inconvenient amount of lost motion, which is one of the most common defects of the lathe resulting from use.

While it may not be desirable in all respects to follow the theoretical method, the departure from its requirements should be but slight, and in no case should the angle of tangent be so great as to throw any perceptible strain on the feed screw of rest. If the fact be borne in mind that the relation of tool clearance to a tangent (no matter of what angle with the vertical) is what affects its cutting qualities, and not its shape and position as regards the hight of centers, there will be no object in following the exaggeratedly high point and incorrect angle so common in the use of the diamond point.

Of hardly less importance is the position of cutting edge of tool with relation to the plane of rotation and surface of the shaft. Though it would seem that the amount of power required to drive the cut should be in proportion to the quantity of metal removed—that is, the area of cross section of chip, or depth of cut multiplied by the pitch of feed—such is not the fact, as is well known to most lathe hands, although the reason is not so well understood. If, for instance, we suppose the depth of cut perpendicular to axis and the pitch of feed each to be $\frac{1}{10}$ inch, the area of cross section of cut will be $\frac{1}{100}$ square inch. The length of cutting edge required, if the tool be set perpendicular to axis, will be the depth of cut plus the feed, which, as each is $\frac{1}{10}$, will be $\frac{2}{10}$ inch. By setting the tool around so that the angle of edge will be 45° in advance of the perpendicular, the area of cross section of cut will be the same, while the proportionate length of cutting edge will be much greater. To be exact, the depth of cut and the feed being alike, the figure of cross section will be a square when the edge is perpendicular and when at the 45° angle a rhomboid. In case of the former, the area is the product of the side multiplied by itself, $= 0.01$ square inch, and the length of the edge the sum of two sides, $= 0.2$ inch. For the latter the side of the rhomboid would be $0.1414+$ inch, which multiplied by its perpendicular $0.0707+$ inch, will give the area, 0.01 square inch. But the length of the two sides representing the cutting edge will be $0.1414+ 0.1 = 0.2414$ inch, or 20.7 per cent. greater than in case of the square.

Just how much this increase in surface of cut increases the power ecessary to drive it would require experiment to determine, there being o data on the subject and no apparent means for ascertaining it by mathe- natical calculation. That it is very considerable, however, is shown by the training and springing of the work and slipping of belts when the angle is oo great; whereas, with a lesser angle—the cross section of area of ut *being* the same—no such trouble is experienced. To demonstrate this orcibly, it is only necessary to greatly exaggerate the angle by setting the ool around nearly parallel with face of shaft, and even under a very light ut and feed, such as would barely be felt with cutting edge perpendicular, he power of belt will be sufficient to drive it. This peculiarity applies qually to planer tools, though the difficulty of decreasing the angle of edge s much less than on the lathe. At the point of tool, whether for lathe or laner use, there should be a straihgt edge, equal in width to about twice the itch of feed, which should be set parallel with face of work. By this eans, deep tool marks are prevented after the roughing cut, and, conse- uently, much less stock may be allowed for the finishing cut.

A modification of this tool called the "half diamond point" is used to dvantage on work from which considerable stock must be removed. They e really, in all essential points, more like a side tool than a diamond oint, and are set with edge nearly perpendicular. They are well adapted heavy cuts, and for car axles, shafting and other similar work, usually one by the piece, are much used. For ordinary work the diamond and alf diamond point may be made full hardness, or, if tempered at all, the olor should be of the lightest possible straw tint. Of course the edge and oint will break if the tool is not of proper shape or if carelessly used.

A very common cause of such breakage is from stopping the athe while cutting and allowing the work to turn backward. This will al- ost invariably snap the point, even though the temper be quite low. All ools are subject to this result if such carlessness is indulged in, and the onsequence will be much loss of time in doing the necessary dressing or rinding and resetting. For brass work the diamond point is inadmissible, t least with the exception of such as is very tough and soft, but it is adapted o all other metals generally used in machine construction A very com- on instance of bad judgment in its use is to run the lathe at a compara- ively quick speed and very slow feed, the idea being, presumably, that the ork is done more quickly than with slow speed and quick feed. But as he friction or wearing action of the metal on the keen edge of the tool may e considered as almost irrespective of whether the feed is light or heavy, follows that with the former the number of lineal feet in the spiral tool ack around the shaft in a given length, and consequently the wear, will be roportionately greater as the feed decreases in pitch. Also the wear of dge is necessarily greater as the speed of cut increases, no matter how ard the temper may be. As a matter of fact, much better time can be ade, on heavy cuts particularly, by using a good, stiff feed and a speed as reat as will not overtax the tool. The use of water for heavy cuts on both athe and planer is quite as desirable for wrought iron and mild steel as it for the "water polish" or finishing cut. It not only prevents burning e tool, bus lubricates and eases the cut.—[Iron Age.

Machinery in Shoemaking.

The chief tools of the shoemaker then consisted of the hammer, his wl, his lapstone, his knives, and his harness for "setting up" his boots or hoes. The essentials of a shoe are the upper, the sole, the counter or heel iffening, and the heel. These parts are again subdivided into the vamp" for covering the front of the foot, the large and the small quar- rs for encircling the ankles, the button-piece, etc. The work of the sho- aker is to prepare and close these various parts of the upper and the lin- gs together, to bring them into the desired shape, to fasten them to the ole which has been previously cut, to attach the heel, and then to give the arious parts the desired finish and style. These processes indicate the nes along which machinery had to be applied. All the operations have een subdivided to the minutest detail, and in the performance of all of em, machines—more or less satisfactory in their workings—have been de- ised. The parts of the uppers are now sewed together by machinery, and ey are pegged, sewed, or screwed to the sole by machinery. Instead of e lapstone and the hammer for condensing the leather are now swiftly re- olving rollers, and instead of the patterns for cutting out the soles are dies r sole-shaped knives set in machines.—[George A. Rich, in the Popular cience Monthly.

THE new magnesium flash light devised by Prof. Schrim, of Berlin, ermany, has been tested, and for signaling purposes it is said to be the uperior to electric light. In order to produce a flash of 400,000 candle- ower, a small quantity of magnesium powder is blown into a benzine gas ame by a draught of air which has passed through pumice stone saturated ith benzine. The light which shows in red and yellow, can be seen at e distance of six miles, even when the sun is brightly shining. An ex- erimental apparatus is being used at the lighthouse on Staten Island, N. ., and the new light will be shown during the Chicago fair.

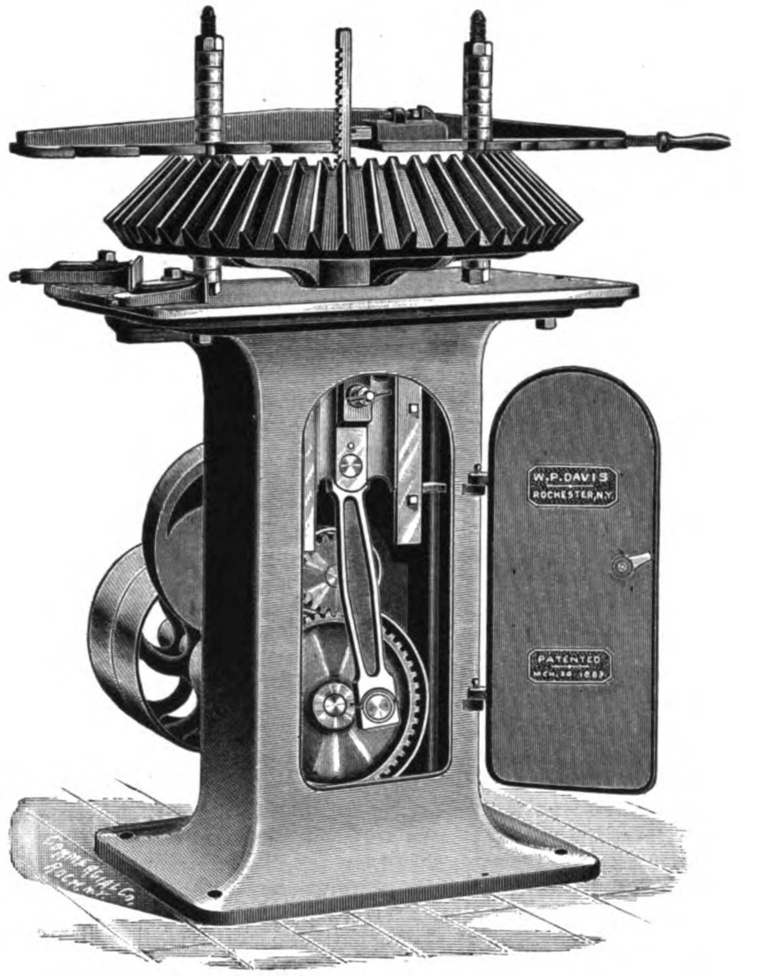
MESSRS. RAGSDALE & Co., Greenwood, Miss., have just purchased eir entire equipment of machine tools, from the Lodge & Davis Machine ool Co., of Cincinnati, O., the well known manufacturers of iron nd brass working machinery.

THE FAIR Co. one of the largest retail stores of Chicago, have just urchased from the Lodge & Davis Machine Tool Co., of that city, n equipment of machine tools for repairing their elevators, electric light achinery, etc.

THE quarantine at Cleveland is said to be the most efficient in the ountry—not excepting New York harbor. Ohio methods of administration ould never have permitted the cholera to enter New York.

THE DAVIS KEY-SEATING MACHINE.

The above illustrates the improved form of the Davis key seating machine that is in use in all parts of the United States as well as in nearly all foreign countries where there is a demand for any kind of machinery of this class. This machine is very simple in construction, yet it has many novel features, being so constructed that it is offered at a very low price, at the same time meeting every requirement of a machine of this kind. The cross head is so arranged as well as the connecting rod that it prevents dirt and chips from getting into the bearings. It is very strongly geared and is a strong, powerful machine that a shop doing any amount of business can hardly do without.



This machine is manufactured by W. P. Davis, Rochester, N. Y. For further particulars, address him.

The Ericsson Submarine Gun.

The trials made with the submarine gun of the Destroyer at the New York navy yard have shown some interesting results. The gun was fired a number of times at different depths under water, and while there was some disappointment as far as accuracy of direction was shown, a record of 10 shots shows that all of them would have hit a ship drawing 22 feet below the water-line at a range of 100 feet. Nine of these would have been effective on the same vessel below the water-line at 200 feet; four at 300 feet; three at 400 feet; and two at 500 feet. The official report has not yet been published, but it may be said that the tendency of the projectiles to rise to the surface was somewhat less than had been expected, and the main difficulty found was in accuracy of direction. Some further trials are still in progress.—[Railroad and Engineering Journal.

AN AMERICAN consul in France reports that the road system of that country (the best system in the world) "has been of greater value to the country as a means of raising the value of lands than have the railways. In France every market cart, with its broad tire, is a road-maker."

Burlington-Route New Service.

A through Pullman sleeping car Chicago to San Francisco is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11:45 A. M., less than four days en route.

Bang! Bang!! Bang!!!

Is heard the gun of the sportsman. Get your outfit together and join their ranks. Tickets at reduced rates are on sale via the Nickel Plate.

Great Reduction In Rates.

To Denver, Col., Helena, Mont., Ogden and Salt Lake City, Utah. Ask Nickel Plate Agents.

A Visit To The West.

Could not be made at a better time than now. Ask Nickel Plate Agents for rates.

Reduced Rates.

To the West via the Nickel Plate.

THE cholera is a dread plague, but science can vanquish it.

RAILROAD MOTIVE POWER.—II.

The inventors of balanced slide valves have heretofore, it would appear, concentrated their inventive genius in the valve alone, entirely overlooking the steam chest. A thoroughly reliable balanced valve requires a remodeled steam chest; nothing short of this will do. The invention of a reliable, simply constructed and cheaply balanced valve will sound the death knell of the present unsightly and cumbersome locomotive steam chest. But, after all that has been said and done on the question of balanced valves, why should the balanced main valve be a sliding valve? Or, if we must retain the sliding feature, why cannot the valve be reduced in size, weight, and end travel? I take these to be pertinent questions, and of no little importance to railroad corporations. The steam chest of the present time must go, and in its stead let us adopt a chest that will accommodate two independent exhaust valves, as well as two independent steam valves, so that we can control in the inflow as well as the outflow of steam at our pleasure.

Another abomination in the sight of the railroad shop machinist, is the method of attaching the steam and exhaust pipes to the nozzles, and particularly the location of the exhaust nozzles. The practice is now to place the nozzles as low down as possible, and after making the joint to fill in around it with a conglomerate mass of bricks and mud. The result of this is that when the engine comes in again for a general overhauling, the machinist and his helper spend the better part of a day, and sometimes two days, in quarrying through a concrete-like mass, in order to get at a half-dozen or so nuts and bolts, and then, perhaps, find that each and every nut must be split in order to get the pipe off, and if they succeed in disconnecting the pipes without breaking off a lug or two they consider themselves lucky.

No bolts nor studs should be used under such circumstances, but instead the flanges should have slotted holes, and tee head pins with split keys to take the place of studs and nuts.

In my opinion steel guides may properly be classed as another abomination in connection with the modern locomotive, and they are closely followed by another known as case-hardened guides. The steel guide under the most favorable conditions, cuts badly, and is too expensive to ever find favor with frugal master mechanics. Aside from this, it is a constant source of annoyance and apprehension to the machinist, owing to the ease with which it breaks while being straightened in the screw-press, even when heated in order to prevent any such mishap. Case-hardened guides, although preferable to steel guides, in the matter of wear, are entirely too expensive, even should they come from the furnace entirely straight and free from checks and seams and with but few blisters. The only redeeming feature connected with case-hardened guides lies in the fact that their faces, being slightly corrugated in the case-hardening process, cause little puddles of oil to form, thereby keeping them constantly lubricated. In my opinion, supported by experience and observation, there is nothing better than cast iron for locomotive guides. Their first cost is very low, they are easily planed and drilled; a set complete being produced at half the cost, and in half the time it would take for either steel or wrought iron. That cast iron guides will eventually supersede both steel and case-hardened guides, there can be no question, when the good wearing qualities of the former, whether in contact with steel, iron or brass, are taken into account, not to speak of their cheapness, as regards first cost and repairs.

For economy, durability and safety, a properly babbitted steel cross-head, running on cast iron guides, stands pre-eminent.

I believe that cast iron should be used in the construction of locomotives where common sense teaches and experiments have demonstrated, that it will answer the purpose just as well as steel or wrought iron, both on account of its cheapness and the facility with which it can be shaped in a machine or at the bench. With a better valve motion, cast iron rock shafts could be substituted for the expensive wrought iron ones, now in general use, without increasing them in size or weight. There is too much money put into a locomotive rock shaft when it is constructed of wrought iron, without any compensatory results. It has been demonstrated, that cast iron can be used advantageously in the link as well as in the other appendages to a locomotive. While we have the link with us let us at least construct it as cheaply as possible. This can be done by making it of cast iron, with the exception of saddle, thimbles (if any), and pins. A solid case-hardened link costs as much fitted up and hung as would three cast-iron links, and eight years' experience satisfies the writer that a well made and properly hung cast iron link will give as good results as the average case-hardened wrought iron link, either solid or skeleton. In view of the foregoing facts with regard to the cast iron link, it would seem, that strict economy, in the department of motive power, should dictate to master-mechanics a trial of it at least. As between a solid and a skeleton case-hardened link there is scarcely any preference, yet it stands in favor of the latter, that a much better job can be made of it as regards twists, and seams on the bearing surfaces, when these occur in the process of case-hardening, and I think that this advantage would go far toward compensating for the increased expense of the skeleton over the solid link.

So much for the link. Now, with regard to locomotive cylinders it would appear that some foundrymen think that the cylinder should be the hardest piece of cast iron used in the construction of a locomotive, if we were to judge by the quality of the castings they turn out. Why master mechanics accept such castings, I am at a loss to understand, particularly when it has been shown by years of experience that extremely hard iron in a cylinder does not wear as well nor as long as iron of medium hardness. Besides this, it costs once and a half as much to complete and hang the former when the items of extra time required to bore and plane very hard cylinders, wear and tear of taps and seamers, destruction of chisels in dressing out the saddle, etc., are taken into account, not to speak of the extreme difficulty of obtaining true surfaces and accurate lines and distances. D.

[To be continued.]

SHOP HINTS.

BY ROBERT GRIMSHAW.

To cut a gear wheel of an unusual size, pitch, or tooth-shape, some times bothers the average shop, which is equipped only with the standar cutters such as are furnished by two or three firms which have had th good sense to make their system of tooth curves uniform, so that ever spur wheel of the same pitch will mesh with every other cut by the same s of cutters. Then again some shops have no large milling machines; som have none at all; so even is they had the cutters they might not be able use them. Again, it does not always pay to get a set of cutters for a which may never have to be duplicated.

For such work it is very often perfectly feasible to use a slotting chine with a cutter of the shape of the tooth space. The wheel or rac blank is first carefully graduated into the requisite number of divisions, there is no graduated chuck on the slotter; then is bolted fast to the slotte bed or table and a scribe mark made on the latter to correspond with on of the division marks on the edge of the wheel blank. Then the tool is s to work until a tooth space is cut; the wheel is then turned or the rack sli along until the second division mark on its periphery or edge is in exa line with the scribe mark on the slotter bed, and a second space cut, an so on.

It is well not to do all the work with one tool, but to have a rough cu taken for each space with a tool which will make the approximate outline and then to finish off with one filed or ground exactly to the requisite ou line.

For this class of work, as for many others, chilled cast iron teeth wil pe found very desirable, as they keep their shape and take greedy cuts, an may be made of a special outline, such as that required for tooth-spac cutting, more quickly and cheaply than by forging.

* * *

Those who have had to plane up large flat and comparatively thi castings, as for printing press beds, stereotyping table-tops, etc., often fin great difficulty in getting them perfectly flat and straight, the reason bein that when the skin is taken off one side the tension in which the cooling o the surface cuts the entire slab is removed, and the plate is found conve on the planed side. There is but one remedy for this, to plane only slight cut all over the side which is to be the finished one; then to turn th slab over and take a slightly deeper cut over the back; then to bring i back with the face up and work the face the second time. By such gradu approach, coupled with proper bolting down to the planer bed, the larges plates may be made as perfectly level as is demanded. They should b tried, after planing, with a slightly bellying file, held in a special holder and then given final finish as to surface, by the scraper. In such wor good surface plates should be used; and these should be tested with eac other and standard, which latter should never be used except for purpose of comparison.

In this connection attention should be called to the habit that som careless workmen have, of putting surface plates while in use, where the will get warmed up on one side or on one not more than on the other, s that they will be sprung by the heat of the sun, or of the steam pipes. The more accurate a surface plate is, the more care should be taken t keep it at uniform temperature all over, and, as far as possible, to hav that temperature the same as that of the material which is compared wit it. If a surface plate which has been lying in the sun and attained a tem perature of 90° is laid on a printing press bed, which, by reason of bein in a dark part of the shop in a draught, has only a temperature of 70° o even 60°, the slab will cool the working face of the surface plate and sprin it out of true plane, despite its thickness or its ribs; in fact, sometimes th thicker it is the more readily it may be sprung.

If the surface plate has an even temperature all over, it will remain true unless laid on something hotter or colder; if it has laid in the sun fac up, its face will get convex; if it has laid back up it will get concave on the face. As most surface plates are longer than they are wide and tend to spring into a cylindrical rather than a spherical surface, the effect of curling by reason of unequal heating may be discovered, and to some extent neutralized in work by using them in two directions; once with their length parallel with the length of the piece being tested, and again with length at right angles thereto.

* * *

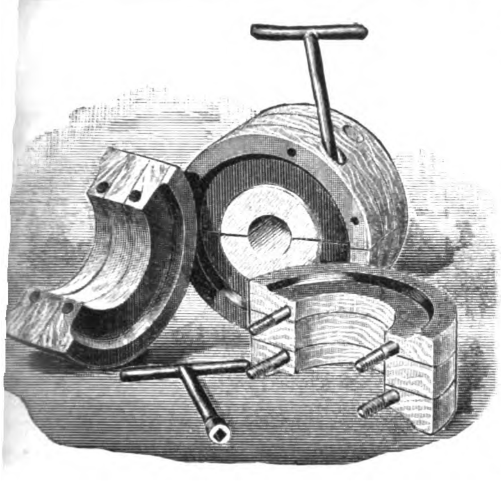
Once in a while there is a demand for a piece of hollow planing, as in locomotive connecting rods; not radial plaining, in which the curve is across the line of action of the tool, but hollow planing in which the cut is required to be deeper at the middle of its length than towards the ends, the depth of cut lessening gradually and regularly from the centre hoth ways. It is a more simple thing to do—when you know how; and all the know-how there is consists in blocking the piece up in the centre so as to spring it vertically as much as the offset or rise of the required curvature, and then plaining straight. On freeing the piece it will resume its straight outline and have the proper face curve.

This lengthwise curved planing may, if desired, be combined with radial planing, so as to give the face curvature in both directions. This method of working is of course only adapted to pieces which are long enough in comparison with their thickness to be sprung on the planer bed.

* * *

Lead-screws that have been used on short work in one part of the lathe to the exclusion of other classes of work and other ways of working them often get out of true. This state of affairs may be remedied in many cases by working along the middle instead of the left hand end of the screw, where possible; and where this is not practicable, by turning the screw end for end so as to bring into use a part that has seldom been given any wear by the slide nut.

Enough care is seldom taken with the lubrication of lead-screws; all



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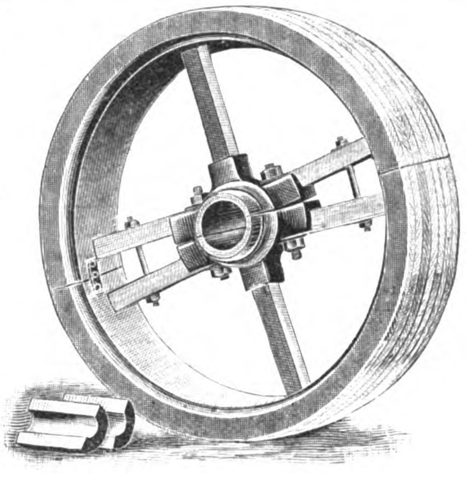


bearings may get enough oil and of the right kind, but the screw is left collect lint and fine filings and dirt that may drop or float that way, and oo seldom wiped clean with waste and given proper oil in liberal quanes. The bearings may be restored to truth so much more easily than lead screw, and wear and damage done to them is so much less inious to the machine and to the work done on it, that it is a wonder that chinists pay so little attention below the shears.

If all those who use files had to pay the bills for them they would be ter taken care of. In the first place, no file is improved by being own about higgledy-piggledy in contact with other files and with other d steel objects; yet this is done every day, at the expense of the cutting ges, every one of which, if not presented properly to hard material, is as der as a good conscience. Files that have been thrown about have ks in their cutting edges (so-called teeth) and particularly in those on ir narrow sides or the edges of the file itself.

Then sufficient care is not taken about using new files only on good particular work. A new file should never be taken to clean castings to do any work where fine result is not desired and where there are casedened or chilled surfaces which will injure its teeth. Yet this is one of most common difficulties to encounter in shops, particularly those ere there is a tool room, and no one man has the certainty that the file t he ruins one day by reason of his being too lazy to go to the tool room get a more suitable one, will ever come back again to him. Files are o spoiled by being allowed to clog up with brass filings and similar maials, which calls for the necessity of putting greater pressure on them in , and produces irregular wear in spots on the file itself, as well as bad rk on the article being filed.

The system of sticking a file up in a bench by its tong is all very well Chili or some such country where, unless that or similar precaution is en, the natives will slip them up their sleeves as fast as the owner's eyes turned; but it should not be at all necessary in this country, and parlarly in a shop where there is a tool room.—["Dixie."

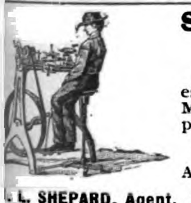
A New Trade Journal.

The Foundry is the title of a monthly publication recently started in troit, Mich. It is managed and edited by Mr. John A. Penton, who has n educated in the foundry and has had newspaper experience as the manr of the *Machinery Molder's Journal.* *The Foundry* is a very bright and ll edited paper. Mr. Penton assures his friends that subsequent issues will only be as good as the initial number, bearing date of September 1, but ter. Mr. Penton is receiving subscriptions very rapidly, and the general ression of good will and intention to support contained in the correspondce, the editor of the SCIENTIFIC MACHINIST saw in the office of *The Foundry* t week, can mean nothing else than a sure forecast of a fine success.

THE article entitled "Analysis and Test of Drawing Paper" in our issue September 1, should have been credited to *The Compass* and William x, its editor, as well as to the *Revue de Chimie Industrielle*, as it was nslated by Mr. Cox for his journal. We cheerfully correct our error in itting this credit. It was not done intentionally.

THE Wells Machine Works, Fostoria, O., have some new and very inesting pipe cutting and threading machines which will soon be put in the rket.

WATCH for the next number of the SCIENTIFIC MACHINIST.



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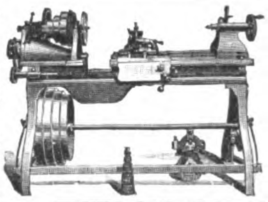

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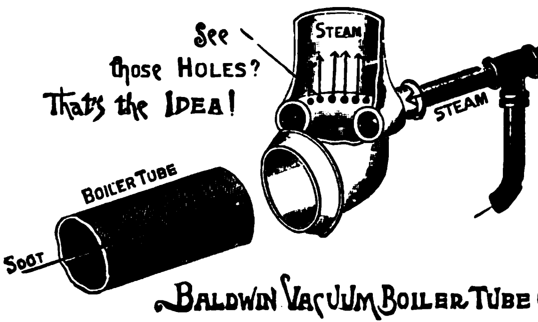
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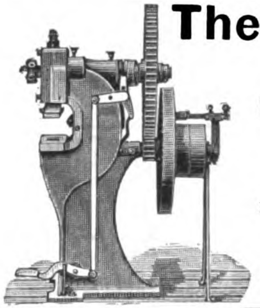

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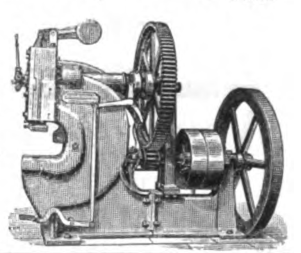

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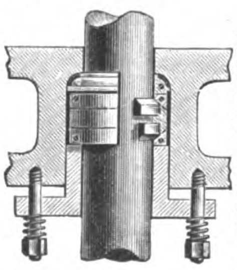

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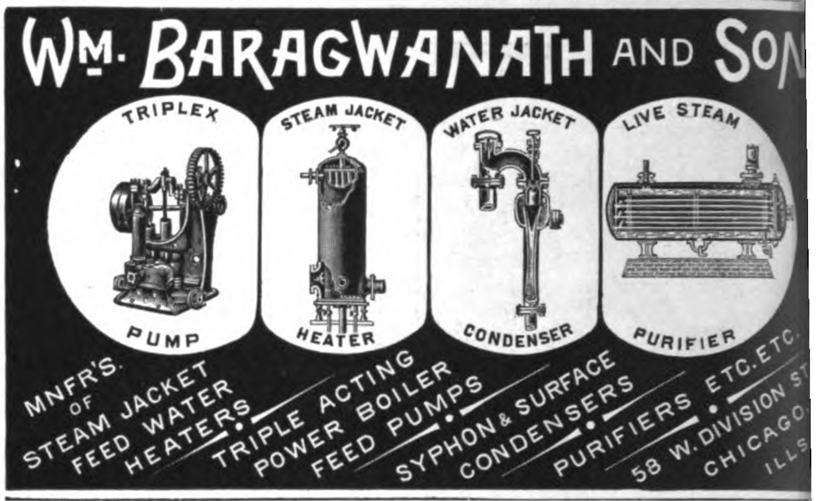

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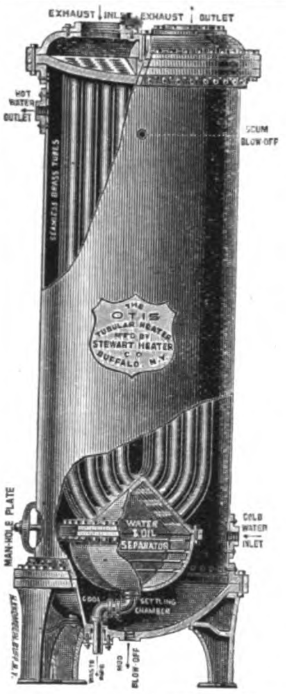

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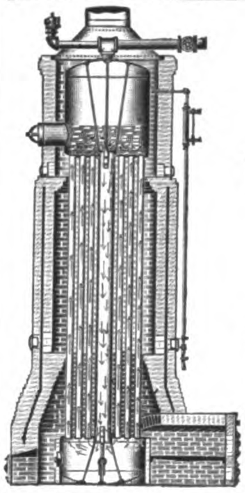

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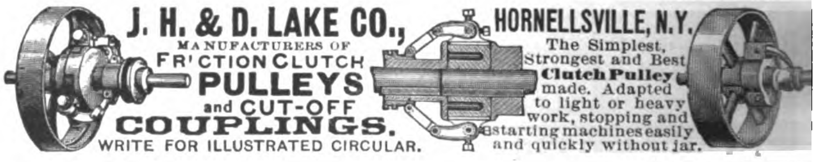

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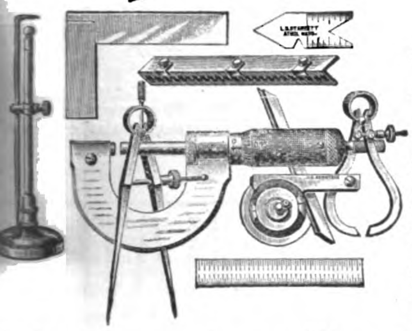

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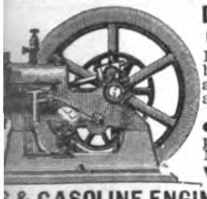

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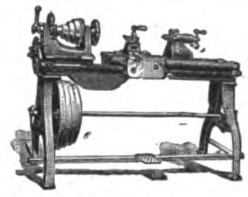

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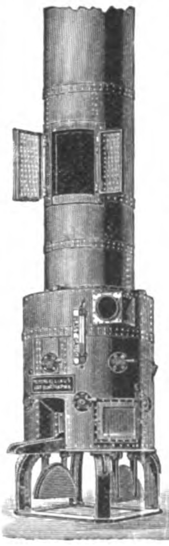

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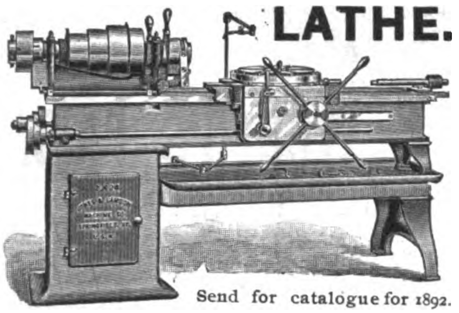

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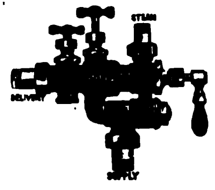

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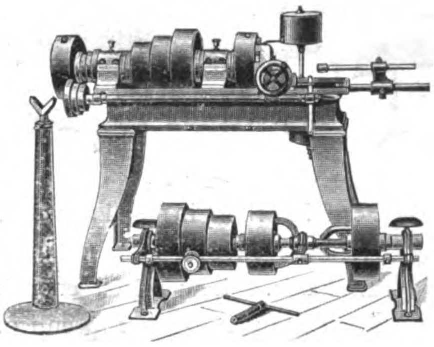

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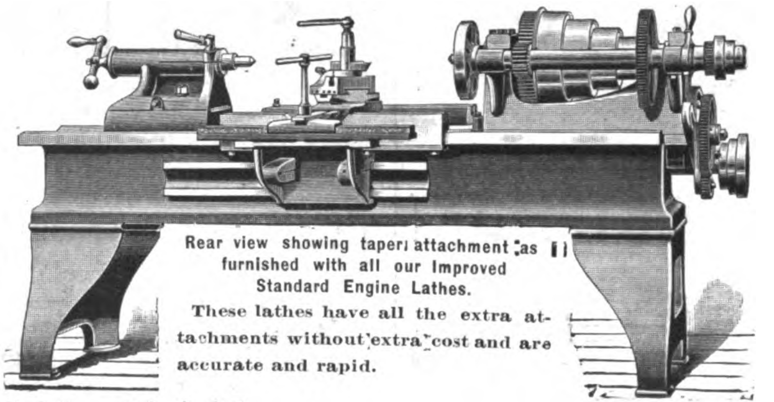

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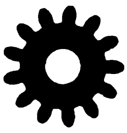

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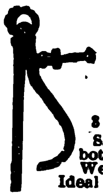

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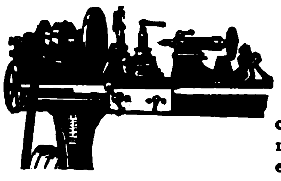

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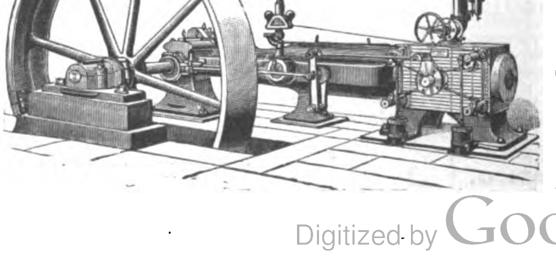

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The accompanying engraving represents an improved power pipe threading and cutting machine especially adapted for machine shop service in requiring but limited space with rapid changes from size to size of pipe, and its ability to receive, cut-off and thread various sizes of pipe without stopping the machine.

The chasers, five in number, are actuated by a convenient cam movement finely graduated with positive adjustable stop, three sets of which thread all sizes of pipe from one to six inches inclusive. They are readily exchanged for chasers of any size or make or pitch of thread either right or left.

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The machine is driven by a cone pulley containing compound back gears completely housed from dust or accident, entirely out of the way and giving six changes of speed; they are central over the base of the machine thus equalizing the weight and placing the driving belt out of the way and in the most convenient position.

The vise is nicely adjusted and self centering and feeds the pipe into the chasers by rack and pinion movement with hand wheel and lever or by friction universal lead screw which is engaged or disengaged by moveing a lever, either of which can be used at will.

The quality of these machines is of the highest grade and their proportions complete.

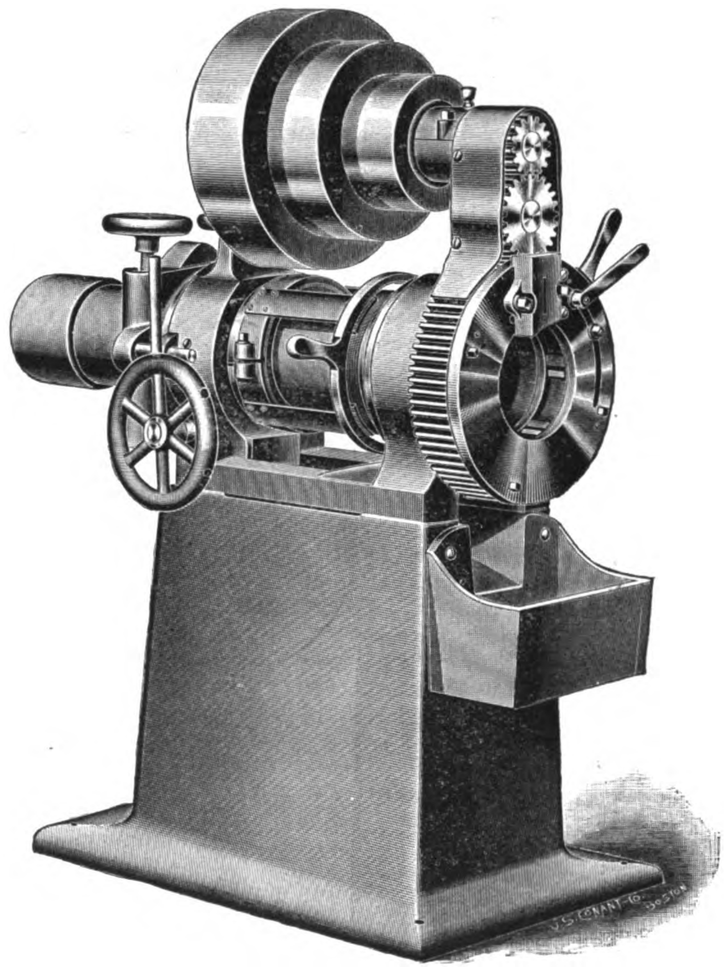
For full particulars pertaining to sizes and prices of their full line address Wells Machine Works, Fostoria, Ohio.

* * *

SETTING THE VALVES OF THE BUCKEYE ENGINE.

BY MARTIN SYMONS.

A question in this paper of the 1st inst., asking how to set the valves of a Buckeye engine was answered all right as far as it went, but it stopped too soon. I hope it will not be amiss if I give a more explicit answer, as I am handling the same kind of engines at present. You must remember that the valve is different from other slide valve engines, as it admits steam through the valve and exhaust at the end of the valve instead of under or through it. In proceeding to set the valves, first, connect valve rod to rocker arm, also rocker arm to eccentric, then revolve the engine and note whether the travel is equal on each end. If not the rod must be lengthened or shortend as the case may be. They should be adjusted at the straps. Second: if the engine runs over (that is if the top of the fly wheel turns from the cylinder) place the crank on the outer dead center; otherwise place it on the inner. Place the throw of the eccentric at an angle of 90 degrees, that is, perpendicular and at right angles with the crank. Now then turn the eccentric forward on the shaft to the amount of angular advance you want it to have, or until you get the required lead on the valve, fasten it there and your valve is set; then you can use an indicator to add the required compression or you can change the length of the connections so as to throw the valve toward the end at which the latest compression took place. Remember that the rocker arm should be vertical at mid-movement, a condition which should not be lost sight of in any case, although exactness in this case is not essential.



V. S. CONANT Co. BOSTON

IMPROVED PIPE THREADING AND CUTTING MACHINE.

To set the autumatic cut-off or governor:

Set the wheels in such an angular position that when the levers rest on their inner stops the eccentric and the crank will be on their dead centers at the same time and in the same direction. The best method is to place the crank on its inner dead center and then set the wheel so that the central rib which supports the projecting periphery of the eccentrics or the plane of separation when made in halves, will be in line with the eccentric rod, or as nearly so as can be determined by inspection, since setting in this position, like setting to the marks, is preliminary and is subject to change to meet extreme conditions if necessary, though in most cases it will be found to give good results.

To set the cut-off valve: The foregoing conclusion having been followed it only remains to equalize the cut-off. If the engine is small enough to handle, block the governor levers as nearly half way out as possible, turn the engine and note the point in the stroke of the crosshead at which the cut-off takes place. Measure the distance of that point from the beginning of the stroke. Do the same for both strokes and if the cut-offs are found unequal find the mean of the two. Place the crosshead at such mean and change the length of connections so as to cut off at that point, that is, so that the cut-off valve be just closed. If the engine is too large to turn by hand or otherwise and no conditions to preclude turning over, loosen the governor wheel on shaft and revolve it on the shaft, find the middle travel of the valve by making the extremes in a convenient manner and setting midway between them. Remove the ballance rings, note position of cut-off valve relative to the parts over which it works. Both of them should show partly open, entirely so at one end, but that at the stem end should show the widest opening by an amount equal to about one-twelfth of the travel of the valve: this will give equal cut-off at one-fourth the stroke.—[The Stationary Engineer.

* * *

IN a recent paper on steel, read by Dr. Anderson before the Iron Institute, England, he is reported as saying that when a piece of solid iron is thrown into a pot of molten iron or steel, the solid metal at first sinks, which shows that its volume is less than the melted substance, but soon the solid piece becomes heated, which causes it to expand, its volume is increased, and it rises and floats on the surface of the molten mass. The action is remarked as being the same both with iron and steel, and is exhibited at once on simply throwing a piece of iron into melted steel, when it can easily be seen to go down, a movement which might be thought to be due to the impetus attained by the piece of iron in falling that height, but as a matter of fact, the iron, if placed upon a fork and lowered without any such impetus, would go down; in the course of a few seconds, however, it comes up again, and keeps on expanding until the piece of iron is a considerable distance above the surface of the metal, when it decreases in volume, and, of course, becomes of the same volume as the molten metal which it joined.

* * *

THE steamship companies have formulated a set of 21 questions to ask applicants for transportation to America. If they suppose that the American people will believe that this will result in restricting the number that will come they are greatly mistaken. It is a bluff and should be treated as such.

RAILROAD MOTIVE POWER.—III.

After an experience of twenty-five years in manipulating and testing locomotive cylinders made of various grades of iron, the writer is led to believe that a cylinder made of medium grade iron, that is easily bored, planed and chipped, is just as durable, and will give better results all around than a cylinder that requires chilled tools, or "special" imported steel to cut it. What folly to make cylinders of iron so hard that the best quality of American tool steel, properly dressed and tempered, will "burn off" in planing it! Like the link, the cylinder made of grate bar iron must go also. One of the prime factors in the general make-up of a locomotive is the steel tire. If the treasurer of a railroad company were to go to his safe and take out $25 in currency and deliberately throw the same into the fire, he would naturally be considered a little "off" in his upper story. Yet this is what he does, so far as loss to the company is concerned, every time a set of steel tires is purchased whose internal diameter is $\frac{3}{8}$ of inch less than the finished diameter. A good lathe hand does not require more than 1-32 of an inch on each side to bore out, and as tires come from the mill now-a-days, this amount of metal is amply sufficient. The machinist who can not clean up the inside of a steel tire, having 1-16 of an inch to go on, had better be put at something else in the shop, and a man that can, put in his place at an advance of 20 per cent. in his wages.

I never could understand why railroad companies should decorate their engines with a lot of brass ornaments, of no earthly use except to throw extra labor on the fireman in keeping them polished up. But, I have known hand-to-mouth companies to practice such extravagance while at the same time they would let a first class machinist go rather than pay him fifteen cents more per day than was paid to the general riff-raff of the shop.

A locomotive should be built for hard and rough usage, and not like a circus chariot, that is more ornamental than useful. Wherever cast iron will answer the purpose of brass it should have preference on the score of economy. Too much brass on an engine, and too little in the driving and truck boxes, will make a train pull hard every time. I believe in putting all the brass used in ornamentation, into the truck boxes. An axle bearing of liberal dimensions provided with a good brass, and well oiled, will run with reduced friction, and reduced friction means a reduction in the fuel account.

There is scarcely any part of a locomotive that requires more care, as to design and material, than the side rod. And, if there is one thing more than another, that tends to keep an engineer in a constant state of anxiety and apprehension while running at a high rate of speed, it is a fluted side rod of the eye-beam pattern, with a web of only $\frac{1}{2}$ inch thickness. The man who first designed this rod no doubt meant well enough but the master mechanic who persists in using a rod of this design, does so at the risk of life and limb, as well as the company's property. A steel side rod of the eye-beam pattern is an expensive luxury, sooner or latter. The old-fashioned side rod, whether round or flat, deep in the middle and tapering toward the stub ends, although perhaps not as handsome as its successor, gave excellent results and seldom broke. The preference, generally speaking, seems to be in favor of side rods of rectangular cross section, made of steel, and fluted on both sides from stub to stub. We are told that if a solid bar of round iron of given weight and length, be made into a tube with wall proportioned to its external diameter, and of the same weight and length as before, it will support a much greater load without permanent set, and at the same time its elasticity will have been increased. It is well known that a side rod is subject to two contrary motions at the same time one in the direction of its length, and the other at right angles to this motion. The force tending to break the rod is centrifugal, and is manifest at a point midway of the rod, if the rod itself is homogeneous.

Elasticity is an essential at this precise point, and it is in this respect that a fluted rod is deficient.

Returning to our solid bar of iron, drawn into a tube of same weight and length, and having increased strength and elasticity, it would appear that side rods could be made hollow, and give the best results, as far as wear, durability and safety are concerned. They could be made cylindrical, of even diameter throughout their length, or rectangular in cross-section, as might be deemed best.

I believe, however, that the coming side rod, with a speed of sixty or seventy miles per hour, as contemplated and predicted by enthusiastic railroad men, will be a sectional or built-up rod, made of iron or steel plates rivited together, the whole to be made solid or hollow, as future experiments may determine. It is obvious that a built-up rod could be finished on an emery wheel just the same as an ordinary flat, or fluted rod, and this, of course, would be reqvired in order to expose any checks in the rod.

I have obtained some data in regard to steel tubes and will here give them as applicable to hollow side rods. The data given may be relied upon as being strictly accurate, having been obtained from a firm of well known manufacturers. A fluted steel side rod, 8 feet 3 inches long, will weigh about nineteen and one quarter pounds to the foot. I have reference to the rod proper without straps, brasses, or keys. The uniform cross section area of this rod would be about $4\frac{5}{8}$ square inches. A solid rod, iron or steel, will weigh from sixteen to 25 pounds to the running foot, and neither one of these can be relied upon for safety. Let us now see what kind of a showing a hollow steel rod would make. A steel tube of $3\frac{1}{2}$ inches outside diameter, with wall half an inch thick can be flattened, or it may be tapered down from the middle of its length toward both ends, and eyes, or, stub ends ends welded in solidly. Taking the tube alone, its estimated elastic stress is from 15 to 16 tons per square inch; estimated tensile stress from 28 to 30 tons per square inch; estimated elongation in ten inches from 32 to 24 per cent., and its estimated contraction of area from 48 to 52 per cent. Weight per foot, 16 pounds and three ounces. The cross section area of metal in this tube is 4.71 square inches, slightly greater than the area of the fluted rod, and yet its weight per foot is three pounds and one ounce less. If we reduce the thickness of the walls to one-fourth of an inch and make the rod tapering towards the stub ends, we can reduce the weight to about nine pounds per running foot and obtain an extremely light, safe, elastic and symmetrical rod; qualities that no side rod, at present, possesses. These tubes are homogeneous and quite smooth both inside and outside, and could be finished on an emery wheel at small cost. There is food for reflection for master mechanics in this side-rod question, and it behooves those having the closest economy in view, as well as safety to life, limb, and property, to give this question something more than passing attention.

D.

(To be continued.)

LECTURES BY THE OLD MAN.

That is a healthy tap; is it not? Two and a half inches in diameter across the large end, two inches across the small end and three inches long, with a hole through it to fit the boring bar as it is supposed to tap a two and a half inch hole in work done on the horizontal mill. Instead of the machine doing it with ease in one minute, it requires a man and a boy with a chain and pinch bar at least fifteen minutes to squeeze it through. It has an odd number of flutes and only about half a dozen threads at the large end of it do any work. As we look over its clumsy proportions it is hard for us to realize that this was not made in some country cross-roads blacksmith shop by some plumber who never saw anything but the old fashioned types of gas pipe taps, instead of coming from the tool room of one of the largest manufacturing concerns in the country, who pay higher wages than any of their competitors, and who have members of that bon ton organization, The American Society of Mechanical Engineers, in their official corps of directors of work, but it is a melancholy fact nevertheless, and that tap is probably but a single instance of the reckless methods employed in designing tools to properly work with. You think they don't know any better? Yes, that may be, but it is more charitable to think a man in authority and drawing a good salary is criminally careless of what is required of him than to suppose that such ignorance of common things can exist in such high places.

Now, how will we go about it to make a tap to replace this one? for you can see that the cost of a new one that will work quick will be small compared to the present expenditure of brute labor required in using this monstrosity. We will make it four inches long with full thread about one inch long at the large end, which should be the diameter of the hole to be tapped; beginning at the end of this one inch we will taper off those threads until we reach the bottom or root of the threads at the small end, which should be just under the size of the hole that has been drilled; we will also put an even number of cutting flutes in our tap and give considerable clearance to the threads or, as we call it "back them off" well. We will make a shank with a slot through it to pin it in place on the boring bar. In operation, our tap will be forced into the hole by means of the rack feed until it begins to bite on to the metal, then we let it alone until it comes out of its own accord. Each one of those threads does its own work, taking off a little more metal than its predecessor until the full threads are reached, when they go to work and clear up the hole to just what we want. The result is our TAP cuts its way through while this other affair is squeezed through by main strength and ignorance.

All taps used on horizontal or any kind of drilling machines should be patterned as near as possible after the standard machine tap (excepting those patent collapsing arrangements.) Then a machine will do in one minute what main strength usually performs in ten or fifteen minutes and will do it far better, too.

Well, Dick, what is the matter that you have not started old Grimes' mill yet? "You could not get the piston in the cylinder after putting those elliptic springs under the steam packing rings; the rings are at least half an inch larger than the bore of the cylinder and you have come back to get the copper ring and those clamps to contract it so it will go in." Pshaw! You don't want to carry those tools out there this hot afternoon. When you get out there, cut some small wedges about five inches long, or, what is easier still, go right up in the pattern shop and have old Glue saw them out for you, about six of them, and then put the piston with springs, rings, follower and altogether in the cylinder and push it in the counterbore as far as possible; then drive the wooden wedges in between the studs in the flange and the packing rings, being careful to tap them all in alike so as to give even compression to the rings, thus drawing them all down below the bore. See? Then take a six by six inch plank about eight feet long and, using it as a battering ram, just drive that piston right home into the cylinder and couple on to the cross-head and let Grimes get his belts moving.

THE OLD MAN.

* * *

A Michigan inventor has contrived a typewriter for musical composers which, he claims, will greatly facilitase operations and secure very satisfactory results. The copy which it makes can be photographed and a plate reproducedfo r printing

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A scientific and practical pamphlet on lubrication by the use of pure, flake graphite. It is interesting and instructive. Send for it.

JOS. DIXON CRUCIBLE CO., - - - Jersey City N. J.

CUPOLA PRACTICE.

BY VICTOR COLLIAU.

(Copy of a Letter to an Enquirer.)

I have received your letter of the 23d, asking for dimensions and proportions of different sizes of cupolas.

I inclose a catalogue of sizes of cupolas, from No. 0 to No. 20, giving diameter of stack and air box, also the height and the inside diameter of lining for a certain quantity of iron to be melted per hour:

Name of Cupola.	No. 0.	No. 1.	No. 3.	No. 5.	No. 8.	No. 10.	No. 15.	No. 20.
Totol height from foundation plate to top of stack.......	50 ft	50 ft	50 ft	50 ft	50 ft	50 ft	50 ft	50 ft
Diameter outside of of Cupola shell from bottom plate to top of stack....	30 in	35 in	45 in	55 in	65 in	75 in	85 in	90 in
Diameter inside of brick lining.......	20 in	26 in	35 in	40 in	50 in	60 in	70 in	75 in
Diameter outside of air box...........	50 in	59 in	69 in	79 in	89 in	103 in	113 in	123 in
Total height of air box..............	6 ft	6 ft	6 ft	8 ft	8 ft	8 ft	8 ft	8 ft
Capacity in tons of Iron melted per hour...............	½ to 1 ton	1 to 2 tons	3 to 4 tons	5 to 7 tons	8 to 10 tons	10 to 18 tons	15 to 25 tons	25 to 30 tons
Quantity of Iron which can be melted economically at a single heat.......	¼ to 2 tons	1 to 6 tons	10 to 20 tons	15 to 30 tons	25 to 60 tons	40 to 100 tons	50 to 150 tons	150 to 250 tons

The height of the charging door from bottom of cupola should be no less than 10 feet for Nos. 0, 1 and 3, no less than 12 feet for Nos. 5 and 8, 14 feet for No. 10, and 16 feet for Nos. 15 and 20.

Two feet higher for all these dimensions would be better, but as a general rule the foundries are built without reference or knowledge of cupola, the cupola coming after has to be made to conform with the building.

For the total height of cupola from foundation plate to top of stack it should be, as for other chimneys, (the higher the better,) but no less than 50 feet, always five to six feet higher than any neighboring building.

A very high stack produces a very great draft which permits a good lighting of the bed, and this is one of the most important parts of the operation of melting, in the cupola.

When the combustion of fuel, in a cupola, is imperfect the escaping gases are hydro-carbon, a gas (the same as our illuminating gas) about 15 times lighter than the air and very inflammable. That is it we see burning at the loading doors and at the top of bad cupolas. This does not require a high stack, the worse combustion at the bottom of the cupola the better at the top of the stack, to the admiration of the ignorant.

When the combustion of fuel in a cupola is perfect the escaping gas is carbonic acid, gas much heavier than air (the air weighs .080,728. ℔ and carbonic acid gas 123.44 per cubic foot) and which requires a very high chimney to produce the draft necessary to carry it away.

The carbonic gas is incombustible and more than that it is an extinguisher and this is the reason why there is neither flame at the loading door of my cupola nor at the top of the stack, and that is why I want a very high chimney.

The distance of the tuyeres from the bottom of the cupola was originally very small, about 12 inches in all the cupolas, that is to say, about six to eight inches of sand bed and five to six inches more from the sand bed to the bottom of the tuyeres.

The result of this arrangement was a very prompt melting after the blast was put on. The tap hole had to be opened almost immediately for there was no room to accummulate the melted iron; the slag also was coming very soon and had to be disposed of.

In many foundries where such arrangement of tuyeres existed the tap had to be left open from the beginning of the melting to the end, which took place when the iron and slag cooled by the blast accumulated at the bottom of the cupola.

The poker used at the tuyeres and at the tap hole could not let out any more melted iron, the cupola was clogged and the operation of melting ended.

A one-ton cupola was then the one in which one ton of iron could be melted before clogging, and a 10-ton cupola (a pretty large one, about 60 inches inside diameter of lining) could melt 10 tons only.

I have changed all this, my cupolas are numbered by their melting capacity per hour, and a No. 1 cupola melts one ton per hour for as many hours as wanted.

A No. 10 cupola melts 10 tons per hour and 100 tons in 10 hours. This is due to the elevation I give to the tuyers above the bottom plate. This leaves a space sufficiently large to accumulate some melted iron in the cupola, making it answer the double purpose of a melting apparatus and a reservoir. By this process, as soon as the iron commences to melt and run, the tap hole is closed and the iron accumulates in the cupola.

When the reservoir is filled with melted iron and it comes to the height of the tuyers, to prevent it from running in them, a hole, called a "slag hole" has been arranged at the back of the cupola and lower than the tuyers.

The slag which is formed during the melting, descends with the iron into the inside reservoir and being the lightest covers its surface. When the iron rises in the reservoir the slag rises with it, staying on the top, and as soon as it comes to the "slag hole" escapes through it; the iron soon follows and runs out; this is the time to tap.

In small cupolas the melting being slow the reservoir must be small, but if it was desired to melt much iron in a small cupola, for instance five tons in a No. 1 cupola, melting one ton per hour, the reservoir should be made larger and that would be accomplished by putting the tuyers higher than for a No. 1 cupola having but two tons to melt to the heat.

The dimensions are:

In No. 1 cupola the height of the bottom of the lower tuyers above the bottom plate should be 18 to 24 inches. These dimensions includes the sand bottom, which is about five inches thick in small and 10 inches thick in large cupolas.
For No. 3 cupola 22 to 26 inches.
For No. 5 cupola 24 to 30 inches.
For No. 8 cupola 28 to 34 inches.
For No. 10 cupola 40 to 60 inches.

I can show you cupolas running of which the inside reservoir is large enough to get out five to six tons tap every 15 minutes.

ABOUT SOUND.

Sound is transmitted to the ear by the vibration of the air. When one particle of air is made to vibrate it sets the adjacent particles vibrating, and so a sound wave, if not obstructed, passes in all directions from the sounding body. The calculated velocity of sound in the air, when the temperature is at the freezing point, is 915.69 feet per second. But the experiments of Moll Vanbeck, and Kuytenbrouwer, performed in 1823 over a distance of 57,839 feet, showed the velocity to be 1,089.42 feet, per second. Laplace explained why it was that the actual velocity was greater than the calculated velocity, by showing that the sound vibrations increase the temperature of the air, and hence the sound travels faster than the calculated rate. This leads us to note the fact that an increase of temperature increases the velocity of sound, by 1-11 feet per second for each degree of rise of Farnheit's thermometer. Hence sounds travel faster in summer than in winter, and in warm than in cold climates. It might be thought that sound would travel more slowly through a dense atmosphere, but the elasticity increases as rapidly as the density, and therefore the velocity of sound is not affected by varying density.

The velocity of sound in water, when at the greatest density, is 4,707.4 feet per second. The experiments by which this velocity was determined were made by M. Colladon in 1826, across the Lake of Geneva, from Rolio to Thonon, a distance of about nine miles. Water, therefore, transmits sound about four times as fast as air does. Still, water is not as good a medium for transmitting sound as the air. If a bell is rung under water and the sound is tranmitted through that medium for more than six hundred yards, the tones are not heard, but only a short, sharp sound, "like two knife blades struck together." Our atmosphere seems to be of just the right nature and density to give to sound its mellow tones and musical cadences. Nor is sound in water diffused around intervening objects as it is in the air. In the air a noise is carried with considerable intensity around a building or wall, but in water an intervening wall intercepts the sound almost entirely.

Here we turn aside to consider a question which, perhaps, has not often suggested itself, but which is, nevertheless, quite interesting. Why can we hear but not see around a corner? Some may think that this question can be answered by saying that light moves in a straight line, while sound does not. But this answer is not satisfactory. It is known that light and sound are similar in character; each is due to the vibrations of a medium, and each is transmitted in waves. Why then, may not light spread around a corner as well as sound? The answer is to be found in the different lengths of sound and light waves. Sound waves themselves are of different length, the graver sounds having waves of greater length than the more acute. Now it can be shown mathematically that the greater length of sound waves will cause the sound to be difused around the obstruction. Hence the bass notes of a band of music are heard more distinctly far behind a wall than the higher notes, and as the person moves out of the "acoustic shadow," the more acute notes increase in distinctness. So, also, when sound is transmitted through water the sound waves are shorter than in the air, and the "acoustic shadow" is fully formed. As the length of the sound waves in the air is sometimes many feet, while the length of the longest light wave is not more than 0000266 of an inch, it is no longer a mystery why we can hear, but cannot see, around a corner.

It is easily demonstrated that the intensity of sound varies inversely as the square of the distance from the origin of the sound. Generally speaking, a sound will be heard farther the greater its orignal intensity and the denser the medium in which it is propagated. The greatest known distance to which sound has been carried through the atmosphere is 345 miles, as it is asserted that the very violent explosions of the volcano at St. Vincent have been heard at Demerara. Sound travels farther and loses less of its intensity in passing through the earth and through the air. In 1806 the cannonading at the battle of Jena was heard in the open fields near Dresden, a distance of 92 miles, though but feebly; while in the casements of the fortifications it was heard with great distinctness. It is also said that the cannonading of the citadel of Antwerp in 1832 was heard in the mines of Saxony, which are about 370 miles distant. —J. A. Moore, in Popular Science News.

* * *

It is stated that the pictures of the Milky Way and other portions of the heavens made by Prof. Barnard of the Lick observatory—taken with an ordinary portrait lens tied to the tube of a six-inch telescope—have never been excelled by anyone and rarely, if ever, equalled, exhibiting, as pictures taken with no photographic telescope could, the wonderful structure of the invisible heavens, with the millions of stars lying beyond the reach of the unaided eye; thus, the number of individual stars shown on a single 8x 10 plate and that of a region not in the Milky Way, and where but few stars are seen with the eye, is estimated to be not less than 60,000, this requiring an exposure of about four hours, using an aperture, of about one-sixth the focal length of the lens. Such pictures require the greatest care in making the exposures and extreme skill in developing the plate to get the best results. Very interesting pictures, however, can be made in less time; within an hour and a half a vast number of telescopic stars will be shown, and such a negative of a prominent constellation, like Orion or Ursa Major, will well repay for the trouble of getting it.

SCIENTIFIC MACHINIST

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WHY THIS ISSUE IS LATE.

In the last issue we announced that alterations would be made in the make-up of the paper, beginning with the succeeding number, and stated that that edition might be late. We had no reason to fear that the delay would be considerable, but the drawbacks in getting out an edition from a new office are numerous, and only with the best of luck can one hope to complete the work in double the time ordinarily consumed.

The difficulties attending the printing of a paper with entirely new equipment are sufficient in themselves to account for a delay. Though the paper is not much altered in size, the form of make-up is entirely different, entailing as much labor as a very radical change in size necessitates. And there is no kind of an office or shop so difficult to get in working order as a printing outfit. No type foundry with which we are acquainted can be relied upon to send an order just right. The variety of material is great, and yet the absence of one of the several thousand parts will bring operations to a standstill till the missing goods are procured. We had more than our share of this kind of experience, and misfortunes continued to follow us through every stage of progress and every department of manufacture. Nearly one entire edition was rendered valueless by an accident. The handicapping unavoidable in working with new machinery could not alone have carried the October 15th issue into November. This number was delayed for several days by the recent great fires in our city, several of which stopped the current which operates the machinery in our press rooms. The building in which our offices are located narrowly escaped destruction.

But we are quite certain that our readers will excuse the enforced wait, and will consider the improved appearance of the paper more than a compensation therefor. The changes are not only in form and material with which the work is done, but extend to the subject matter. We shall have more to say concerning our editorial arrangements in a short time.

The SCIENTIFIC MACHINIST is steadily and rapidly forging to the front. We have not bored our readers with double-leaded editorials dilating on the number of papers we print, but we now take occasion to state that, according to the information given by those who devote their entire time to ascertaining such facts, there are but three mechanical or trade-mechanical journals in America that have a larger circulation than the SCIENTIFIC MACHINIST. We can prove this to the satisfaction of any candid person. When the paper was turned over to the present managers there were twenty or more that stood ahead of it in this respect.

The publishers are now far better equipped, in every way, to make a good paper and push it to the front than at any time since the journal was founded, nearly eleven years ago. With our greatly increased facilities our energies will also be redoubled. We leave the results to the future. Our readers will not be slow in observing them.

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THE EXHIBITS AT THE STREET RAILWAY ASSOCIATION MEETING.

The exbits at the Cleveland meeting of the Street Railway Association were far ahead of expectations.

Among those whose display attracted unusual attention may be mentioned The Westinghouse Co., The General Electric Co., The Walker Mfg. Co., The Brightman Stoker Co., Lodge & Shipley Machine Tool Co. and R. D. Nuttall. The Walker Mfg. Co. displayed a fine line of wheels and patterns that were examined with great interest. Mr. Wm. Lodges's exhibit consisted of his well-known and remarkable pulley lathe—a tool that every electrical concern should have. It was in operation and its many advantages were seen by hundreds of visitors. If the favorable comments from electrical men may be taken as an indication, Mr. Lodge will be well satisfied with what he accomplished in the convention.

The meeting passed off very nicely. The weather was uniformly good and every one enjoyed himself.

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THE Columbus Celebration was a success all over the country. In Chicago, where the World's Fair Buildings were dedicated, the ceremonies were imposing.

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ELECTION bets seem to have taken a back seat, but election guessrs are just in style.

QUESTIONS AND ANSWERS

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(448) A. C. Werkheiser, Silverton, Colo., writes: "Please tell me how to test a steam guage so it can be depended upon. When I test mine I want to know I am right." A.—The only way it can be tested so you can depend on it is to use a test guage or mercury column.

(449) "Amateur," Bedford, Ind., writes: "This is the first time I ever got so bold as to ask questions through your paper. I have always been backward about talking. 1. Is there any difference in the pressure on the bottom and top of a boiler when steam is in the boiler, at any pressure? I had an argument with a friend about it. He said it was easier to force water in at the top of a boiler than at the bottom. Which was right? I was of the opposite opinion. 2. What is the principle on which a balanced valve is made, in relation to an engine? Have most locomotives a balanced valve? 3. I wish also to ask your advice on a matter of mere personal interest. I own a small lathe, and have made a small engine of the oscillating type, which is simple and has few parts though it is strong. It is a triple expansion engine. The cylinders are ½ inch, 1 inch and 1½ inch in diameter, with a 1 inch stroke. I think it is worth something; that is, the style, as it can be made cheaply. What I would like to know is whether you can tell me what to do with it. I am not able to spend anything on it unless it is of value." A.—1. The steam pressure is the same on all parts. The pressure on the bottom is as much greater than on the top as the weight of the water in the boiler. 2. It has spaces underneath, or between the valve and seat, which are filled with steam and counterbalance the steam pressure on top of it; by so doing it reduces the friction between the valve and seat. There are a great many different kinds of balanced valves and it would be difficult for us to give you any particular design or description; but the above is the principle from which they all work. 3. Regarding what you can do with your engine, we would say that the way to ascertain its value is to inquire of engine manufacturers.

(450.) Wm. Gray, New Orleans, La., asks: "What lift should a receiving valve, discharging valve and check valve have on any kind of pump." A.—There is no particular rule governing the lift that the valves in a pump should have, it depending upon the speed of the pump and the pressure it has to work under. It is customary to have the combined area around the valves, when open, equal the area of suction pipe for the suction valves, and the discharging pipe for the discharging valves. The lift for the check valve depends on the pressure; it is customary to give it the same as the area of the pipe.

(451.) J. V. B., Rochester, Ind., writes: Please inform me through your valuable paper how to prepare graphite to use in steam fitting. making joints." A.—Mix with plumbago and boiled linseed oil.

(452.) C. H. G., Milwaukee, Wis., writes: 1. "I have charge of a large pump, supplying water for four elevators. The water is pumped into a tank on top of the roof and from this tank it goes through the elevator into a tank in the basement; thence up again, using the same water over all the time. The water gets very rusty and I want to know if I can put some sal-soda in it to keep it from rusting, or will the soda eat the pump cylinder. 2. Can you tell me what a nickel plating bath is made up of, what kind of acids and what quantities are used, and what kind of a process the piece to be plated has to go through before it can be put into the bath. Also where I can get the cheapest and best nickel anodes." A. 1.—Sal-soda will prevent the water from rusting, but you must be careful not to get any more of it in than is sufficient to soften the water. Would advise you to change the water occasionally. 2.—See article on nickel plating in SCIENTIFIC MACHINIST for Jan. 1, 1892, page 6.

(453.) W. McKenzie, Buffalo, N. Y., requests: "Please give me an answer as to how I can bore out a hole, say six inches long taper, if I did not have a compound rest on my lathe. For instance, the hole would be 3½ inches at one end and three inches at the back, and there is a three-fourth hole through the back." A.—Turn the taper as near as possible by hand; then make a reamer a proper taper.

(454.) Jesse Kirkland, Fair Dealing, Ky., inquires: 1.—"Is it of any advantage in learing marine engineering to already understand Stationary engineering? 2. Where and how can a man get a job of "helper" or "striker", or is that the best way to learn marine engineering." A.—1. It is. 2.—The best way would be for you to get work in some marine-shop and in this way become acquainted with the marine men.

(455.) C. A. Rollins, Weld, Maine: Give the height of water in your boiler, and state whether you wish to know the pressure when the blow-off pipe is open.

(456.) Geo. Inman, Tippecanoe City, O., writes: "I made, or tried to make, a storage battery, on a small scale. I took common lead plates 18 inches long, 5 inches wide, ⅛ inch thich, two in number. I put them in two different glass jars, connected with lead wire and filled jars with sulphuric acid, diluted, one part of acid to 12 parts of water, and connected to a battery in good working order. The storage cells will not fill. I kindly ask what is the matter with it, or is it with me?" A.—Cut three lead plates of equal size, with projecting ears on each one. After having roughened the faces of all the plates with a file, paint one plate with red lead, quite thick, mixed with sulphuric acid and the other two plates with litharge, similarily mixed. Let them dry, then put into any kind of a jar, glass or metal, making sure to keep the plates separated from each other by small porcelain knobs, placing the red lead plate, which is the positive, between the others, which are the negatives. Duplicate this arrangement in a second jar and connect the inner plate of one jar to the two outer plates of the other jar, and from the inner plate of the second jar run a wire to the copper of the gravity cells, and from the zinc of the gravity a wire to the two outer plates of the first jar. Do not connect until the jars are filled with diluted sulphuric acid. Then use about six or eight cells of the Crawfoot gravity battery. When the charging progresses the middle plate should turn a dark brown color and the outer ones a slate color. When using current from the jars the plates will again return to the same color when they are empty.

(457.) G. B. C., Leicester, Mass., asks: "Why does not a dynamo, in running at 75 volts, give a more brilliant light with a 16 candle power lamp than with a 20 candle power lanp? If the machine is gauged to run 16 candle power lamps, I should think if you put on a larger lamp the light would not be so bright." A—If the 16 candle power and 20 candle power lamps are of the same voltage then, obviously, to get 20 candle from the one with the same pressure as for the 16, the resistance of the lamp must be less, so as to allow more current to pass through and produce more light. The resistance of a larger candle power lamp is less than that of a smaller one, hence the current is greater in quantity, making a brighter light.

☞Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

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The Manufacture of Lenses.

In the city of Munich is one of the most celebrated lens manufactories in the world, its wonderful products being in demand in all the countries of Europe. The perfection characterizing these lenses is due to the unvarying precision and faultlessness of work applied to every object produced before it is permitted to leave the Steinheil establishment. The lenses, after being roughed out in cast-iron moulds by hand, are ground fine by means of emery powder and water in glass moulds, each workman being provided with a glass model of the surface to be imparted to the lens (such surface in all cases being spherical) and each is tested to see that it has received its proper curvature by means of a so-called spherometer. The different operations of grinding, finishing, polishing, centring, &c., are all performed by separate workmen, who are practised in one of these particular branches only.

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Don't you think the Scientific Machinist is a better looking paper than before? We do.

PRACTICAL LETTERS

How He Stopped the Flowing of Water From One Boiler to the Other.

EDITOR SCIENTIFIC MACHISIST:

As Mr. H. Heyrodt says, I do not know as it is right to dwell on the subject of the two boilers any longer, but being requested by my brothers to let them know how I overcame the difficulty, I feel it my duty to write once more on the subject.

To stop the flow of water both to little boiler and engine I took the tee from the center of the steam pipe and placed it on a nipple, four inches long on the dome of the big boiler, that being the boiler nearest the engine. I stood the tee on end, connected the little boiler on the top end of the tee and connected the engine to the center of tee. That stopped all trouble and I have had dry steam ever since.

If Mr. H. Heyrodt will take into consideration that there are two valves instead of one he will understand the pressure and also that the valves were set so that the crank had passed the center on its return stroke before there was any lead.

A. D. Joels.

Expense—Packing Rings—Babbitting on a Shoe.

EDITOR SCIENTIIFIC MACHINIST:

I have had charge of a 14x42 E. P. Allis Corliss engine built at Milwaukee, Wis. I have run it four years and it has run night and day and I never have had a hot bearing in that length of time and never had a flue leak. My expenses in four years have been two dollars worth of files and four dollars worth of babbitt. The packing ring gets to rattling in the cylinder, but then I take them out and pear them. According to my experience, it is always best to take a piece of hard wood and set it on end and lay the ring on and hammer light blows in the middle. Be carefnl not to hit the ring on the edges. In babbitting a shoe on a Corlisss engine draw a line through your cylinder and let the string go through the crosshead and over to the crank pin,

Louis Ademson.

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FITTING A CRANK-SHAFT.

A machisist who had a large number of small crank-shafts to fit up from the forging, found that he was able to shorten operations considerbly by a few carefully studied "dodges." The shafts were for hoisting engines, and were about two feet long, and a half-inch in diameter, and had the crank part forged solid. The first thing the man did, says the "Tradesman" was to mark the crank out roughly, then drill it out, and turn the shaft roughly to about the desired size. The ends of the shaft had to be drilled and squared up in the usual manner, and each end of the concern was turned up as far as the crank. The workman took the precaution to put a square bit of iron in the crank while he was turning the shaft. This prevented any springing of the crank from pressure of the lathe centers or the cutting tool. There would have been no danger of the crank springing during the turning if the crank had not been slotted out before the turning, but in that case, there would have been trouble from another source, for the very act of cutting out the crank would probably have so altered the strains in the metal that it would change shape slightly, probably throwing the shaft out of true while so doing. By slotting the crank first, the slight change in straightness of the shaft can be corrected by the turning thereof.

After the rough turning was finished, the crank part of the shaft was attended to. The shaft was not finished complete, at once, for the same reason that the slotting could not be left till the shaft was finished. The best plan, therefore, is to work each part, along a little at a time, taking some mettle off one part, then some off another so that only a light finishing cut is necessary over all to finish the whole. To turn the crake, some false centers had to be made and fitted to the exact length to which the shaft crank was to be finished. These centers were made with hubs bored out to fit the shaft, of which about two inches had been turned to the required size on each end on purpose to receive the false hubs. To the hub was attached an arm as long as the throw of the crank and a rib was cast on the back of the arm to stiffen it to the hub. In making these false centers, they were first bored out to fit the shaft, then driven on, faced up all round, and drilled while on the shaft so that there could be no doubt as to the arms being of the same length.

A set screw was put in each arm to supplement a fair drive fit. It was not possible to have them drive hard enough to hold without the set screw because of their having to be adjusted to fit the true crank when in the lathe. All being ready, the false centres were driven on the shaft, which was put between centres and the rest brought up till a stiff tool placed therein, would just have a bearing under the crank. A smooth, true casting was then put on the lathe bed, and a surface gauge placed on casting. The curved end of the scriber was brought to touch the top of the shaft, and the tool adjusted till it would hold the crank at the same height. The side of the crank was level when in this position, and as the wrist pin was to be of the same diameter as the shaft, the centres of shaft and wrist would also be level. By means of a mark previously made on the lathe, the straight arm of the surface gauge was brought exactly to the height of the lathe centre, and tried to see if it would go into one of the centres on the false arm of crank. If not, the false crank had to be adjusted till the scriber would go into the centre. Then that one was tightened up hard and fast.

The casting on the lathe belt was then moved along and the other false crank adjusted as the first one was. A very accurate and easily made adjustment is made by adjusting the tool on top of the crank instead of underneath it, and then screwing up the tail-spindle so that the crank will be held for turning. Then, with a little bit of a jaw screw, or a bolt working in a long nut, the false cranks may be set by first making sure that they are too low, and raising them with the screw already described. There must be a final testing of each false crank to see that they are right, then with the set-screws up tight, and light chips taken on the work, a very true crank should be made in a comparatively short time. It does not pay to try to turn the ends of the crank with a tool, and hand motion of the shaft back and fourth. At least it does not pay when there are several of them to be done. It is cheaper to rig up a mill in the lathe (unless, as there should be, there is a milling machine in the shop,) by putting a short, stout arbor on the slde-rest, and belting to an overhead counter. Then the milling cutter can be adjusted to the right place and depth, and the shaft revolved by hand, a lever being clamped on it for that purpose. A very good milling job can be done in this manner, and by doing a part of the work on each centre, the two ends of the crank can be done, leaving only a pair of tangets to be planed or milled up to finish the job.

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Turning a Shaft.

There are three reasons why it is best to turn as little as possible off the outside of wrought iron or steel shafts. One is that it costs more to take a deep cut than to take a slight one; and a second is that the more you take off the greater you waste; and the third, of which very few take special notice, is that the further from the outside you go the poorer the material; this being true both of castings and of forgings or of rolled articles. Turning down shafting is only to make up for imperfections in surface or in diameter. If shafts could be rolled perfectly true in surface and in section, there would not only be no necessity for turning them down, but there would be an actual loss in doing so; it would be paying money and taking time, to lessen the value of the article. But where shafting has to be turned down, one thing should be done; that is, start with a sharp tool and with a good enough tool to be able to take the full length of the cut without any perceptible wear of the tool; for every 1-100 of an inch that the tool wears in length, makes the shaft 1-50 of an inch greater in diameter; and there is no earthly use in having even a six inch shaft 1-50 of an inch larger at one end than at the other. Another advantage in having the tool sharp is that the sharper it is, other things being equal, the more likely it is to keep on cutting instead of starting to dig in. A sharp tool will trim off the edge of a seam or skim off the edges of a soft place, where a dull one will refuse to do it and will go fighting for a place to dig in and sulk. That is one of the several reasons why emery and corundum wheels do better work in making calender rolls and milling rolls than the best turning tools in the best of lathes can do, with the best of workmen; and this is one reason why in ordering a steam engine you should be particular to specify that the crank pins should be ground after turning.—Robert Grinshaw in "Dixie."

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New Wagner Buffet Sleeping Cars.

Will hereafter be run on the Nickel Plate trains Nos. 1 and 2 between Buffalo and Chicago.

STRUCTURE OF THE STEAM-ENGINE.—III.

BY PROF. R. H. THURSTON.

The Greene Steam-Engine, (Fig. 38), has four valves as in the Corliss. The cut-off gear consists of a bar, A, moved to the steam-eccentric in a direction parallel with the centre line of the cylinder and nearly coincident as to line with the piston. On this bar are tappets, C C, supported by springs and adjustable in height by the governor. These tappets engage the arms, B B, on the ends of rock-shafts, E E, which move the steam-valves and remain in contact with them a longer or shorter time, and holding the valve open during a greater or less part of the piston-stroke, as the governor permits the tappets to rise with diminishing engine-speed, or forces them down as speed increases. The exhaust-valves are moved by an independdnt eccentric-rod, which is itself moved by an eccentric-set, as is usnal with the Corliss and with other engines gnerally, at right angles with the crank. This engine in consequence of the independence of the steam-eccentric, and of the contemporary movement of steam valve-motion and steam-piston, is capable of cutting off at any point from beginning to nearly the end of the stroke. The usual arrangement, by which steam and exhaust valves are moved by the same eccentric, only permits expansion with the range from the beginning to half-stroke. In the Corliss engine the latter construction is retained, with the object, in part, of securing a means of closing the valve by a "positive motion," should, by any accident, the closing not be effected by the weight or spring usually relied upon.

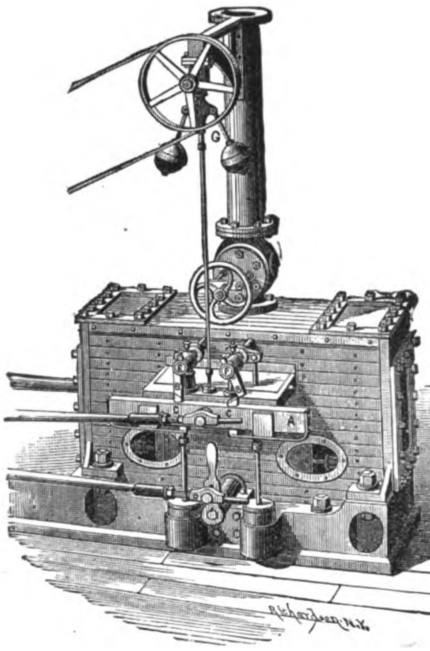

FIG. 38.—GREENE ENGINE VALVE.

There are other engines belonging to the class here considered—engines having a detachable cut-off valve closed independently of the motion of the valve-gear,—of which space will not permit description. Among these are the Wright engine, constructed by one of the oldest and best known designers in the United States; the Brown engine, a machine which has been extensively adopted for driving mills in New England, and is famous for the excellence of its workmanship and finish, as well as for its durability and efficiency; the Fitchburg engine, and others.

An ingeniously arranged engine of the class considered in this division of the subject, the Wheelock engine, is seen in the accompanying engraving.

The steam-chest is placed below the cylinder, and the steam and exhaust-valves are set side by side, the latter serving both as induction and eduction valve, and having the same action, nearly, as the common three-ported slide-valve; while the function of the former is principally that of a cut-off valve. The latter, or main valve, is set nearest the end of the cylinder, and the exhaust steam is thus permitted to escape directly, and promptly from the engine. The valve and seat are independent, and coned slightly, and may be adjusted to take up wear, or to relieve pressure on the seats. These valves are carried on steel trunnions, and with hardened surfaces of contact are but little subject to wear. The steam or cut-off valve is set farther away from the cylinder than in the standard arrangements of Corliss and other builders of that class of engines, and this enables the maker of this engine to secure a single port with reduced clearance and less liability to leakage, should the expansion-valve leak. In the later engines of this class a gridiron valve is used in a shell of the same general form. In this engine—and it should be the case in every engine in which the regulator is driven by belt—the connection from shaft to governor is so made that the breaking of the belt permits an automatic closing of the valve and the stopping of the engine. The regularity of motion of the class of engines described in this section may be inferred from the fact stated in regard to the engine here studied, that it has been known to vary but a half-revolution per minute when five sixths of the load was thrown off.

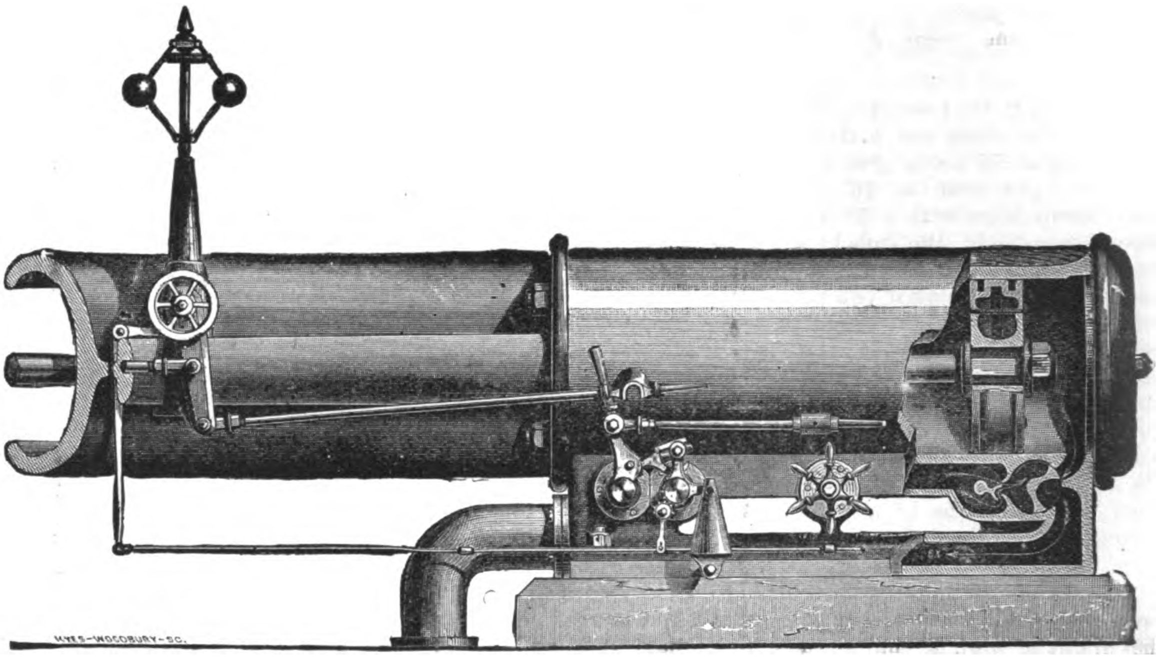

FIG. 40.—THE WHEELOCK ENGINE.

Simple and Compound Stationary Engines are both in common use as mill-engines; and all the familiar classes of engines are constructed in both forms. Until recently the mill-engine has been very generally a single-cylinder engine, or a pair of simple engines coupled with cranks at right-angles where great power was demanded, but the Corliss and other mill-engines are now often "compounded," and it is not unusual to compound comparatively small high-speed engines. In such cases the elements of the combination are commonly similar in design to the simple form of the same engine. The combination is often made by constructing a "tandem" engine, in which the cylinders are placed in the same line, end to end, and often with their pistons on the same rod. In other cases, the engines are set side by side, actually constituting each a complete engine, with their cranks set at right-angles for a two-cylinder compound, or at angles of 120 degrees for a "triple-expansion," engine, and with a common frame. In such cases, an intermediate "receiver" is introduced into which the high-pressure cylinder exhausts and from which the low-pressure cylinder takes its supply without seriously affecting the working of the fluid.

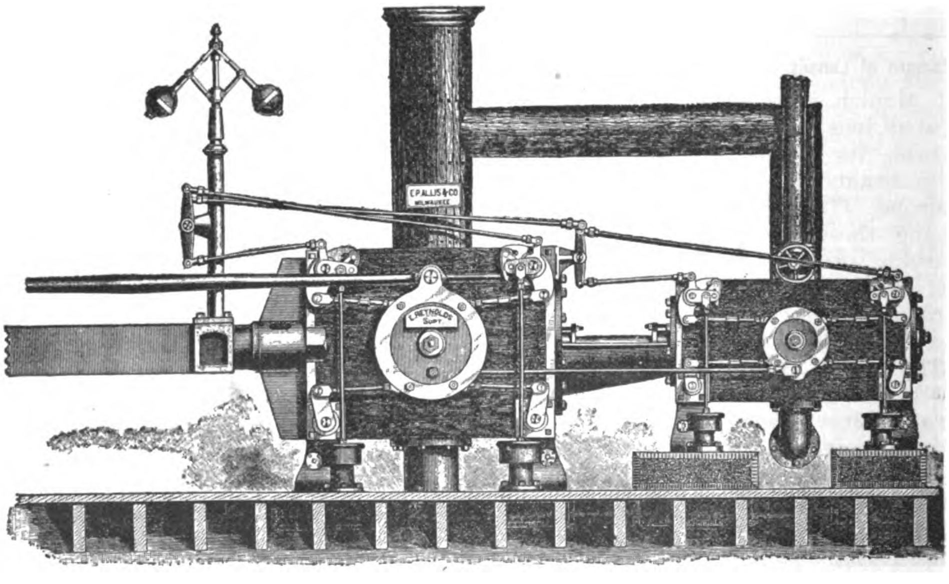

FIG. 41.—"Tandem" COMPOUND ENGINE. (Scale 1-24.)

Nearly all the engines to be described are thus built "compound," and some are "triple expansion."

The Stationary Multiple-cylinder Engine is rarely given the same form as the marine engine. The necessity of having a pair of cranks, and the objection to the employment of the fly-wheel, do not here exist; nor does either the volume or the weight of the machine become so vitally important a matter as at sea. The design adopted is, for these reasons, one which will be of minimum first cost, irrespective of these considerations.

The "Tandem" Engine is perhaps the most common form of stationary compound engine. In this type, as shown in the accompanying illustration, the two cylinders are set in line, have a common piston-rod, and drive the same crank. The high-pressure cylinder is commonly placed behind the low-pressure, and the latter is directly attached to the frame of the engine. The exhaust of the smaller cylinder is carried in any convenient manner to the large engine; but the more direct and the larger the conduits employed, the better. In some cases, the two cylinders are set directly in contact. This plan involves a difficulty, usually, in packing the rod between them, but it has the advantage of great compactness. The Compound Corliss Engine was first introduced by other builders; but no one was more successful in the economical working of the machine than was its great originator, the late George H. Cor-iss. The usual method of compounding this engine for stationary purposes is that known as the "tandem" system, in which the high-pressure cylinder is set behind the low-pressure, both pistons having a common rod and driving a common set of reciprocating parts and having valve-gearing actuated by the same eccentric and rod. The plan is simple, inexpensive, convenient, and compact, and is found to be very satisfactory in operation, the economy attained by it being about as high as that of any other arrangement yet devised.

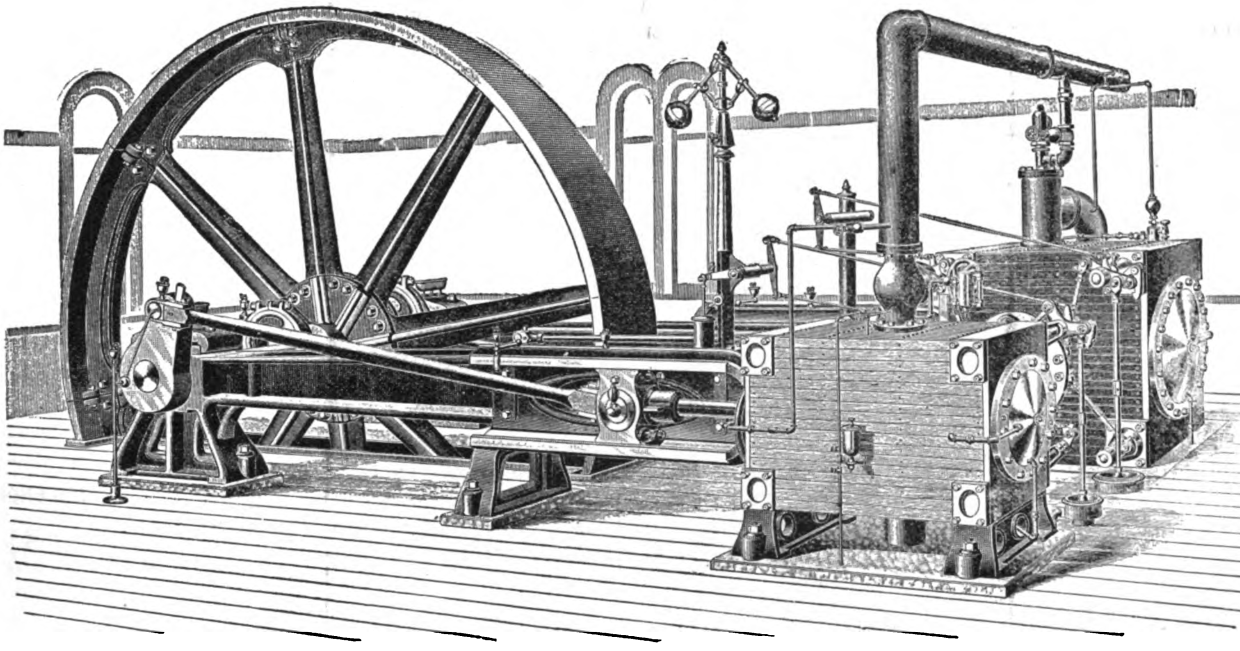

FIG. 42.—"GROSS-COMPOUND" ENGINE.

This method is illustrated by Fig. 41, which exhibits a form of the engine designed by Mr. Edwin Reynolds. It is readily seen that it would probably be impossible to find a better method of combining maximum efficiency with minimum cost of construction than this, or to make a more compact disposition of parts. It is necessarily of considerable length; but in other directions has no greater dimensions than the single engine of the simple type.

The performance of this type of engine has been most excellent. For example, the engines of the Nourse steam-mill, as constructed by Mr. Corliss, were found to demand no more than 1.62 pounds of good fuel per horse-power and per hour. The same engine as a simple engine, the high-pressure cylinder disconnected, if epual to the best of its class, under similar conditions of operation, would probably not require less than two pounds; which may be taken as about the limit of economical working for that type of engine, with a good condenser and dry steam.

One disadvantage of this type of engine—the "tandem"—is the length of passage between the exhaust-port of the high-pressure and the induction-passage of the low-pressure cylinder when the former is taking steam in the backward stroke; but this is partly compensated, at least, by the very short passage obtainable for the opposite movement. The valve-gearing is commonly the same on both cylinders; but it is often so arranged that the governor operates on the one cylinder only, leaving the ratio of expansion of the other to be determined by the measure of expansion in the first.

Another not uncommon system of compounding this engine, especially for large powers, is oftener practised in Europe than in the United States. This is coupling of two engines, side by side, as in common marine practice; while another method sometimes adopted is the adaptation of two independent engines of properly-adjusted sizes to act, the one as the high, the other as the low-pressure engine of a compound system. These engines are occasionally set at some distance apart, when the local conditions make that a more convenient disposition. The efficiencies of these several types of compound Corliss engines are substantially the same. They are all subject to about one half the internal wastes of the simple engine of similar dimensions, to about the external wastes of heat, and have a trifle more friction. On the whole, they will ordinarily give an increased economy amounting to about twenty per cent of the heat and fuel consumption of the simple engine.

In some cases the arrangement of a pair of complete engines, of properly selected sizes, in such manner that either the exhaust of one may be used in the other, or steam may be taken direct from the boiler to either, is found advantageous. When less power is demanded, or when one is disabled, the available engine may then be used alone. Economy has been attained by this plan, even when the two engines are placed at considerable distances apart, the precaution being taken to carefully guard against loss of heat between them.

The "Cross-compound" type of Corliss engine is illustrated by the accompanying sketch of a pair designed by Mr. Reynolds and built by Allis & Co. for the Namquit Mills. The cranks are set at right-angles, and the receiver is placed be neath the floor. This is a less common variety than the "tandem" form; but is still often adopted.

(To be continued.)

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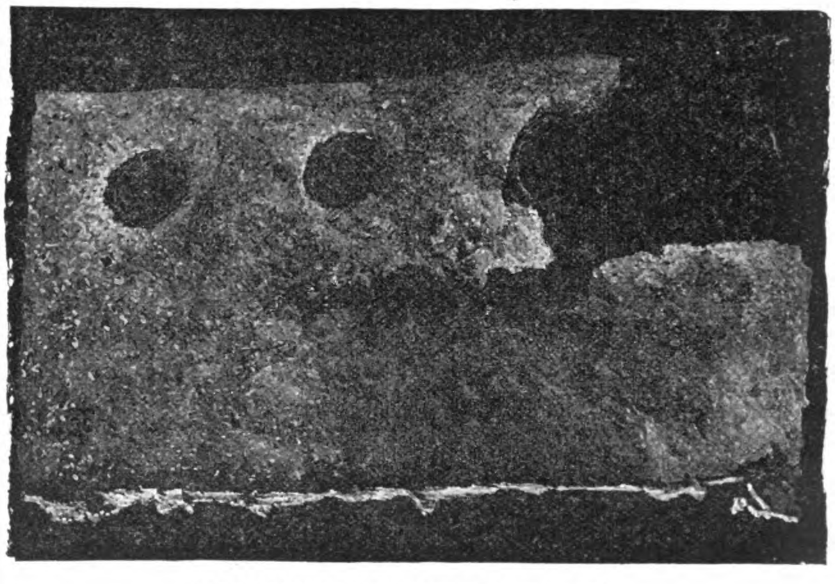
THE machinery trade of the country is good. No presidential year has been equal to it. This augurs an extraordinary activity during the two closing months of 92

CORROSION.

Corrision is responsible for a large class of the defects that we meet with in the inspection of boilers. It causes rapid deterioration, and is especially dangerous because it is often unsuspected, even in bad cases. When the action is internal it may be due to impurities in the water, but it is more frequently caused by allowing the boiler to stand idle for considerable lengths of time, with water in it, ready to start up; and it is particularly noticeable in boilers used for heating purposes, for these are frequently left all summer with water standing in them. If the boiler is kept lukewarm, as, for instance, when it is fired up only once or twice a week, the action is usually more rapid than when it is constantly cold; but in any case, pitting and corrosion are more destructive in boilers that are comparatively idle than in those that are in constant use. This fact has not escaped the attention of the chief engineers of the fire departments, who now almost universally put in auxiliary boilers in connection with those on the engines, in order to keep up a proper circulation and maintain a steam pressure. Many persons suppose that this arrangement is designed to ensure having steam up in case of fire; but while this is certainly one great advantage of the plan, the increased durability of the boiler is an equally important one.



CORROSION FROM ACCUMULATED ASHES.

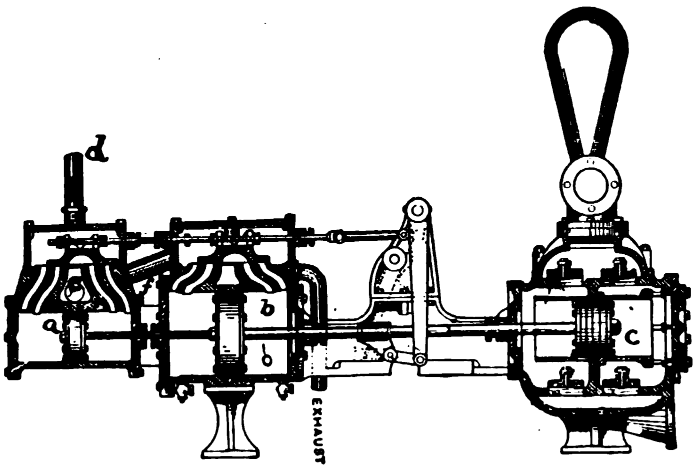
In previous issues we have given illustrations of the pitting and corroding action of water, and in the present issue we present an engraving showing the effects of corrosive action of a different kind, arising from a different cause. It is frequently met with in the inspection of the fire-boxes of internally-fired boilers. The space between the fire-box and the grate bars, in these boilers, becomes filled with ashes, which are often allowed to get damp and attach themselves to the plate, or to pack themselves tightly in between the plate and the bars. Then if there is the slightest leakage or dampness these ashes begin at once to corrode everything in contact with them, and in a short time the boiler becomes unsafe. The piece shown in the cut was taken from a furnace about two years old and fully one-quarter of an inch thick. It was taken out just against and above grate bars, and in places it was only 1-32 to 1-16 of an inch thick. This same state of things extended entirely around the fire-box.

The rapidity of the action in cases of this kind is caused partly by the character of the ash, and partly by the closeness with which it clings to the plates. The engineer is easily deceived as to the real state of things if he allows these incrustations to collect, for there is no evidence of corrosive action until the plate is destroyed, unless the coating is removed. No furnace should ever be allowed to get into such a condition. The accumulations should be removed every day by passing the cleaning hook between the grate and the plates of the water leg. It is good practice, also, to remove the grate and thoroughly clean the adjacent plates once in six months, painting them, after cleaning, with red lead and oil. This will check the corrosion in all cases, and unless leakage occurs it will stop it entirely.—Locomotive

STEAM PUMPS—VI.

BY J. C. SMITH, M. E.

As there is no moving mass of metal, such as a fly-wheel, to store energy in the beginning of the stroke of the pump, and converting it into work at the end, the pressure of steam against the piston must be a constant one throughout its entire movement; that is, steam can be used expansively on a duplex pump. This defect makes the machine a wasteful one, as steam is exhausted at the end of the stroke into the atmosphere at boiler pressure.



In order to obtain a higher economy, pumps of the larger sizes are compounded; that is, they are fitted with larger cylinders called low pressure cylinders, into which steam exhausted from the high pressure or smaller cylinder acts upon the low pressure piston; and, in this way, work is done by the high pressure exhaust steam in allowing it to expand against a larger piston, and thus making it more economical than a duplex pump performing the same work. The principle of compounding was invented by Hornblower in the latter part of the last century, and has been brought to a high degree of perfection by engineers of the present time, by employing a high boiler pressure in contrast to that pressure used in earlier times, and increasing the number of cylinders to three and four, thus carrying a higher initial pressure and increasing the number of expansions of the steam. Although these improvements apply to the steam engine, they are applied to the direct acting pump as well, some of which have been built triple-expansion.

The accompanying cut is a longitudinal section of a compound duplex pump in which a is the high pressure cylinder, and b the low pressure cylinder, both placed tandem with regard to relative position; both high and low pressure pistons are secured to the same piston rod to which the water piston c is fastened.

It will be seen from the cut, that both high and low pressure valves are driven by the ordinary duplex motion, and that the valve stems are carried through both valve chests in order to drive both valves by the same stem.

The action of the pump is as follows:

Steam from the boiler enters the high pressure valve chest through the pipe d and its action on the piston a is controlled by the enclosed valve and allowed to pass through the live steam port at the left and forcing the piston a to the right. The exhaust steam in the opposite end of the cylinder passes through the exhaust port into the exhaust at e; it is then conducted by means of the high pressure exhaust pipe f into the low pressure valve chest passing through the port on the low pressure cylinder as shown in the cut, and acting against the left hand face of the piston b, and thus assisting the steam acting on the high pressure piston a in moving the water piston c to the right.

The steam in the low pressure cylinder on the opposite of the piston b passes out through the exhaust port as shown, into the atmosphere or led to the condenser where it is converted into water.

These two methods of disposing of the exhaust give rise to the two classes of pumps which are called "compound non-condensing" and "compound condensing." The latter class is more economical than the former, for, by the condensation of the exhaust steam, a vacuum is formed on the exhaust side of the low pressure piston and therefore removes the back pressure, and increases the efficiency of the pump.

The use of either of the two classes depend to a great extent upon that which is more abundant in the locality, coal or water, for what is saved in coal by the use of the compound condensing engine must be sacrificed to a certain extent by the use of water in keeping the condenser cool.

It will be seen that there is an expansion of steam in its passage from high pressure to low pressure cylinders, first, in filling the high pressure exhaust pipe F and low pressure valve chest, and, second, since the area of the low pressure piston is much greater than that of the high pressure piston, that, as the pistons move on in their stroke the space occupied by the enclosed exhaust steam becomes greater and therefore the pressure falls gradually through the stroke until the end is reached, when by the reversing of the low pressure slide valve it is led to the condenser.

In proportioning the relative areas of high and low pressure it has been a question to decide what is the most economical expansion, and a relative proportion in area of about three to one is generally used.

The relative position of the steam cylinders is something of much importance in the design of a pump and for pumps of smaller dimensions that arrangement as shown in the cut is generally used, as it is much cheaper; but, in pumps of larger capacity, the high pressure cylinder is set between the low pressure and water cylinders, and rests upon a base of its own.

By arrangement of this kind it will be seen that access is obtained to both cylinders to adjust the packing of the pistons without disturbing the main parts of the engine which is not the case with the engine shown in the cut.

Care should be taken that there is no communication between the right and left hand high pressure exhaust pipes f. Often, in being cast as twin pipes, blow holes occur in the separating partition, and thus leaving communication between the cylinders of both sides of the pump.

The reason of this is obvious, for, assuming the right hand side of the pump to be moving until it has thrown the valve of the left hand side, the steam to be exhausted in the left hand high pressure cylinder has to fill not only the low pressure valve chest and cylinder but owing to blow holes in the separating wall of the high pressure exhaust pipe it has to fill the low pressure cylinder on the opposite side also; and, as this last piston has almost completed its stroke, this new influx of steam has to fill a large space before its pressure is materially increased.

This defect is very readily detected by placing the indicator on either low pressure cylinder and is shown by the sudden increase of pressure on the expansion line caused by the inflow of this new body of steam.

Very often these compound pumps are used for the double purpose of water supply and fire pumps. In this case communication is made between the pipe d and the high pressure exhaust pipes f with a valve to control the inlet of steam from the pipe d to the pipes f.

The object is to use steam at high pressure on both pistons f and b thus increasing the power of the pump and, consequently, the pressure on the water piston, a change which is of advantage in case of fire. In its ordinary duty these valves are closed and it performs its work as a compound duplex. If the pump is used condensing, provision must be made to turn the exhaust of the low pressure cylinder into the atmosphere, for, when used as a fire pump, the condensing apparatus would be unable to condense the increased volume of steam.

It will be noticed that both of the steam cylinders are double ported, the outer pair being used as steam ports while the inner pair is used as exhaust ports, for reasons explained in a previous article; the steam ports are filled with regulating valves to govern the length of the stroke as before explained. In large engines rolling valves driven by the engine are substituted, for the hand wheel, and have the advantage of being automatic. When the work of moving the steam slide valves is excessive, they are balanced by some contrivance in the chest to remove the pressure from the back of the valve, and reducing the coefficient of friction between valve and seat and permitting it to be moved more readily. In the matter of condensation of the exhaust there are three systems: the connected condenser, the independent and a surface condenser which is placed in the discharge main; the exhaust steam is brought in contact with the condensing tubes of the condenser, while a small air pump carries away the condensed steam.

This system has the advantage of requiring the handling of but little extra water for condensation of exhaust steam, while the water in the main is but slightly warmed. It is also constructed in such a manner that repairs can be made upon the tubes, such as putting in new ones or calking leaky ones without disturbing the flow of water through the main.

The connected and independent condensers are principally used in connection with compound condensing pumping engines, the independent condenser being used with the smaller engines; more will be said about condensation and its principles in our next.

JOB-SHOP EXPERIENCE.

When taking a deep cut in the lathe where it was necessary to work with the tool run out several inches beyond the tool-post, a mechanic found that the tool chattered and sprung so badly that it was impossible to do good work. As the job had to be done in that, and no other manner, he began to look around for some means of keeping the tool stiff. Finally he hit upon placing a rod of steel under the tool and letting the lever end of the rod rest on the carriage as far down as it was possible to locate it. In this position, the rod acted as a brace to the tool which was kept stiff enough to do the work in good shape. But the rod gave trouble by ocassionally slipping out, and this was cured by drilling a shallow hole in the lower part of the carriage, just deep enough to keep the end of the tool from slipping, and then making another hole in the under side of the tool. The top end of the tool was pointed and made to fit into this hole. As a further improvement, the rod was made adjustable in length and was found to be a very desirable addition to the stock of lathe tools.

LIME AS A FLUX.

The value of lime as a flux for use in welding steel is not appreciated by mechanics in general, and perhaps it is not known to many. It is well known that borax is a flux to so many of the metals that it has become known as almost a universal flux, but there are some metals —a very few—which do not work with borax. The chief office filled by a flux is to form a coating over the metal which will exclude the air, thus keeping away the corrosive oxygen, and permitting the metal to be heated above the point at which it would burn if exposed to the atmosphere.

Sand forms a flux for iron, but is not worth a "continental" for steel. The reason is that the silicon which does the business requires so high a heat to become melted, that the steel is burned before the flux gets in its work. Another failure is because the silicon does not flow over the steel as well as over iron, owing no doubt to the chemical difference of composition between the two metals. This seems to be proved by the fact that sand containing a considerable amount of aluminum (clay) will answer passably well as a flux for steel. It is possible in a limestone country like the South, to always be able to procure at will a good flux, for the common lime rock, pulverized, will do the business very well. It may either be used pulverized in its natural state, or it may be put in the fire and burned into quick-lime before being pulverized. In either case it works well, but a little better in the form of quick-lime.

A NOVEL BLAST LAMP.

When a man wants something better than the Bunsen burner, and larger than the blow pipe flame, he can rig up a lamp that will melt quite large pieces of brass wire, or even iron. The concern is also especially applicable where gas is not to be had for use in Bunsen burners. The rig consists of a large alcohol lamp, above which is mounted a small copper or wrought-iron boiler, spherical, and from two inches in diameter upwards, according to the size of the lamp and the work to be done. The boiler must be fitted with a screw-plug for filling, also with a little safety valve, otherwise accident may occur from an over pressure in the boiler. The boiler is filled half full of alchol, although benzine, naptha, or even kerosene oil may be used. From the top of the ball a pipe leads down to the burner, and terminates there in exactly the same manner that a blow-pipe tube would terminate. In using steam consisting of the vapor of alcohol, or the oil used, is generated in the boiler, often under considerable pressure and being carried to the flame of the lamp, not only is the function of the ordinary blow-pipe flame performed in an improved manner, owing to the steady and high pressure at which the blast is delivered, but the blast itself is of an inflammable gas which has also been heated to the igniting point. The rig forms a very desirable addition to the kit of a jobbing mechanic, and is independent of the city gas service. By surrounding the object to be operated upon with charcoal, and then allowing the blast to play upon it, a degree of heat is reached which is suprising, to say the least, to a man who has never seen the thing work.

HOW TO REGULATE SPEED.

A man who had to cut a screw thread on a cone, found out some things that he had never dreamed of before. He found that when the work was set over in the lathe, that is, when driven by a dog, the speed of the work was different from the speed of the lathe. That at two points in the revolution, diametrically opposite each other, the speed of the work would be faster than the speed of the lathe spindle, and that at two other points, the speed of the work would fall behind that of the lathe. This was when the work was driven by two studs located opposite each other. The machinist, to satisfy himself, removed one of the studs and found that one of the slow and one of the fast places had disappeared, but that the irregularity in the speed at the maximum and minimum points was now twice as great as before.

This circumstance afforded the clue which enabled him to arrange a drive that would give a regular speed to the work. He reasoned that if two driving points would reduce the amount of the record one-half, that putting in many more driving points would bring the error down so small that it would be inappreciable. Following out this line of reasoning, he put on a pair of bevel gears to drive the work, which increased many times, the driving points, when compared with the one or two supplied by the studs. It may not be generally know to mechanics, but two beveled gears of the same kind, and exactly alike, will help a man out of a bad scrape when it is necessary to drive two shafts at an angle other than ninety degrees.

For heavy work, it is necessary that the gears be selected so as to mesh along the whole length of the pitch line, but for cases like the driving of work in the lathe, the corner of one face of the gear will carry power enough to do all the work. In applying power to water wheel governors, it is often found a puzzling job to make connection with the wheel shaft owing to the angle at which connection can best be made to avoid timbers and bridge-trees. In these situations, a pair of bevel gears, both alike, but selected so that the proper angle will be filled, will form the best possible, and cheapest way getting over the difficulty mentioned.—[The Tradesman.

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In the carrying out of the recently proposed plan for utilizing smoke, a practical illustration of its value is cited in the fact that several Scotch iron works are receiving an annual rental from a certain gas company for the privilege of collect ing the smoke and gases from their blast furnaces. The smoke and gases are passed through several miles of wrought iron tubing, diminishing in size from 6 feet down to 18 inches, and, as the gases cool, there is deposited a considerable yield of oil. At one of the smallest of these installations—a Glasgow plant—there are pumped and collected about 60,000,000 cubic feet of furnace gas per day, and on an average some 25,000 gallons of furnace oil are recovered weekly, using the residual gases, consisting chiefly of carbon monoxide, as fuel for distilling and other purposes, while a considerable yield of sulphate of ammonia is obtained. In a small way a small percentage of the British coke ovens are fitted with condensing gear and produce a considerable yield of oil, for which, however, in its crude state, there is but a limited market, the chief use being for lucigen and other lamps of the same description; also for treating timber for railway sleepers.

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New Service.

If you are going either East or West try the New Train Service on the Nickel Plate. Elegant Wagner Buffet Sleeping Cars.

HINTS TO ENGINEERS.—XIII.

BY EDWIN WOODWARD.

Before commencing to tram an engine all the joints, straps, slides, journal-caps, and all adjustable parts should be a snug fit. It is hardly necessary to say that the engine should be in good running order or the valve properly set, as the tramming would be of no value if it were not so. But with these conditions and cautionary measures, care should be taken to give the piston equal clearance at both cylinder heads. This is best done by taking down the connecting rod, and shoving the piston back till it strikes the cylinder head, as fig. 11 indicates. Then draw a line upon the cross head and guide bar as indicated at A. Then by means of the cross-head draw the piston forward till it assumes its dotted position, and the piston strikes the forward head, then a mark on the guide at A' in line with the mark previously made on the cross-head will show the extreme length of the cylinder, and show when the piston is reaching the danger line. But if the cross-head is provided with shoes or gibs to make adjustments for wear the trams as shown at B and B' may be substituted for the lines with equal precision if not so convenient. By putting up the connecting rod now the clearance at either end may be seen—the distance the mark on the cross-head is from the mark on the guide bar giving it. If not equal it is usually became the connecting rod has become short by taking up the wear in the brasses, and it may be corrected by putting liners of sheet metal between them and the stub end, until it is the same at both ends. In many engines the piston rod screws into the cross-head and the adjustment for clearance may be made through that medium before tramming, but it is obvious that other adjustments must be had.

In tramming, it is customary to place the engine near the center for the reason that the valve there is traveling fastest and any slack in any of its joints is less liable to cause trouble than if it had been trammed while the eccentric was going over its center. As the work can be done as well in every particular and in some cases with decided advantages it is preferable to place the engine on the center to perform the operation. The tram should be made of a steel rod with both ends sharpened and bent downward as fig. 12 shows, with the points not closer together than the length of the stroke. Select a point on the bed of the engine, between the valve and connecting rod and mark with a center punch the point A, fig. 13, in such a place that the tram will reach B on the crank disc and C on the eccentric—marking both places with the punch as A. This locates the dead center and also the position of the eccentric, and are thus easily found should occasion ever require it.

Then proceed with the tramming, by marking the valve rod as at D, and also the piston rod as at E. Sometimes it is impossible to tram an engine throughout from a single point as at A, but if the length of the tram can be so arranged as to make this possible, it will often save a confusing mass of pricks, but when two or more base points must be located, it is essential that they be made on an immovable part.

All engines are not provided with a disc as fig. 13, but many are provided with the crank, fig. 14, or the center crank. The tram B, fig. 13, on these styles is not available to mark the center, but the tram should be placed at about right angles as H, fig. 14, shows,—all should be set in line with the quickest moving. Two prick marks on the fly wheel the length of the tram F, fig. 12, will permanently fix the length of the tram, and should it become bent, or lost, its original length may be restored without trouble or delay. This method of marking of course cannot fix the place of the valve, should it slip or become by wear out of place within the steam chest. By removing the steam chest cover, the position of the valve may also be marked with the same tram, taking a point on the valve rod as a base. Should the valve become displaced, not having been marked in the chest, the advantage of tramming the engine while on the center would then be apparent, the engine then being in the right place to re-set the valve. All engines are susceptible to this system of marking, although the various automatic and Corliss valve gears require a more extended operation. The point to be observed is to tram from some fixed part, preferably the engine bed, and as before stated, have the tram in, or nearly in line of path of the most rapid movement of the part trammed.

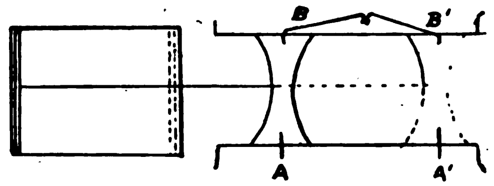

Fig. 11

Fig. 12

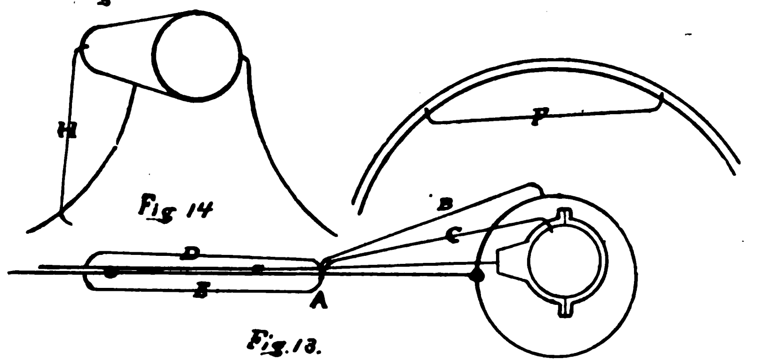

Fig 14

Fig. 13.

ERRORS IN THE DESIGN OF PULLEYS AND SHAFTING.

BY ALLEN N. LUKENS.

In the following paper I propose to notice some of the causes of waste in power transmission by pulleys and leather belting, leaving the amount of loss to be determined in each special case. A line of shafting is subjected to two strains, viz., a transverse strain, due to the various forces applied perpendicularly to it between the points of support, and the torsional strain, due to the forces turning the shaft by means of the driving-pulley. The transverse strain, due to the weight of the shaft itself and the pulleys it carries, is increased by the tension of a belt running downward from the shaft and decreased by that of a belt running upward. The resultant transverse strain, due to a combination of the foregoing with those due to horizontal or inclined belts, is to be found by the parallelogram of forces.

It will be seen at a glance that the less transverse strain there is the easier our shaft will turn. To keep the flexure of the shaft down to the minimum it is best to have the hangers so spaced that they will come as near as possible to the pulleys, especially the larger ones; and for the same reason, belts pulling off opposite sides of a shaft should be as near as possible to each other. Main driving-pulleys should always have a hanger on each side. This practically prevents all flexure of the shaft—a flexure which, when considerable, very quickly tells on the life of a plant. I have no accurate figures at hand as to the cost of loss of power from this cause, but perhaps some of the members can recall something on the subject and present it in the way of discussion. The torsional or twisting strain on a shaft is greatest near the main driver, and decreases as power is taken off the shaft, becoming zero (except for friction at the bearing) at the end of the shaft. When the shaft is very long and light, the torsional strain is apt to produce a very undesirable jerky motion at its extreme end. This can be reduced by placing the main driver in the center of the line, thus reducing the strain upon the shafts. This arrangement allows the use of lighter shafts with a reduction in the first cost. All possible care should be taken to have the bearings rigid, so that they shall hold the shaft firmly in place. At the same time they must not bind the shaft.

In a small mill in one of our Southern States, where I was at one time engaged, there was a very marked and expensive case of too tight bearings. On taking charge I found that while the boilers were doing exceptionally well, and while the indicator showed the engine to be working to perfection and developing nearly 125 horse power, there was always a scarcity of steam. I at once ordered an examination, with the result that all the bearings in the place, from the head of the main shaft to the smallest journal on the ore concentrator, were found to be so hot that water would boil when thrown on them. After going over these, putting in liners, repouring ect., where necessary, until everything worked smoothly, the engine was found to be exerting only 115 horse power, showing an enormous, almost preposterous loss through this cause alone. The fuel used was green pine-wood, and before the overhauling five and a half cords were required for a 10-hour day. After the readjustment the consumption of fuel fell to five cords per day. One cord of this kind of wood is equal to about 1,000 pounds of coal, which, at $2.25 per ton, would be $1; so that the daily saving of half a cord resulted in an economy of 50 cents.

Shafting is often very greatly handicapped by the faulty application of the pulleys and belts. The most serious error made in this connection is that of running unreasonably tight belts. It is amazing how much power is wasted in this way, to say nothing of the trouble of broken pulleys, hot boxes, etc. The enormous and absolutely useless pressure thus put upon pulleys must in time break them, besides wearing out the system of shafting and bearings. If manufacturers realized what these ridiculously tight belts cost them in a year they would give vent to some very strong and expressive language. It has been calculated by several eminent engineers that the loss of power from friction alone, in some of the best epuipped mills in the country, is from 22 to as high as 39 per cent. It is unreasonable to suppose that the minimum friction would consume this amount of power, and no other cause is so potent in increasing friction as undue tightness of belts, which, when they number by hundreds in a mill, easily account for the great loss of power referred to. Estimating a horse power as requiring a consumption of 40 pounds of coal per day of 10 hours, and granting that 15 per cent. is a reasonable allowance for loss of power through unavoidable friction, and taking the actual loss of power at 22 per cent. (the lowest of the figures given), we have a balance of seven per cent. as the actual loss. This would be 2.8 pounds of coal per horse power per day. In a plant using 200 horse power this would mean 560 pounds of coal per day, which, at $2.25 per ton, would cost 65 cents. For 300 days running in a year this would mean $195, to say nothing of the extra wear on the hangers, the shortening of the life of the belts themselves, and so on. The point next in importance to the tension of the belts is the arrangement of the pulleys. These should be as large as is consistent with a proper regard for symmetry and proportion; for the larger the diameter of a pulley the less the pull necessary to transmit a given amount of power.

The use of too small pulleys, by decreasing the liability to slipping of the belt, is often responsible for the employment of excessive tension in the latter. The following case in point came under my notice: A few feet from the end of a line of shafting and near the end hanger was an 18x6-inch pulley driving a line of counter-shafting with a duplicate pulley. Noticing an odor of hot oil about the mill, I made an examination, and found that it came from the end hanger referred to, which was too hot to bear one's hand on. The engine was shut down and a thorough inspection ordered, which brought word to the office that the shaft had worn through the babbitt in the box and was running on the cast-iron. As this was not a very satisfactory explanation of the trouble, I investigated further and at once saw the real cause. The belt had been slipping badly, and had been taken up. Still it slipped, so another piece was cut out, until the tension had caused the shafts to cut through the babbitt, and also pulled the hangers on both shafts considerably out of line. On questioning the man in charge it was found that this belt had always slipped ever since it was put in, being thus a continual source of trouble, besides wearing out the belt very qnickly. A new belt had been put on only three months before, and was now entirely useless. The only spare pulleys available were two of 34-inches diameter by four inches face—that is, nearly twice the diameter of the former one and two inches face less. These two pulleys were put on and an old four-inch belt used having the proper tension. This has been doing the work with entire satisfaction ever since, now nearly two years, showing conclusively that the whole trouble came from the use of a small pulley which required an undue tightening of the belt in order to avoid slipping. The distance between centers of these shafts was 22 feet, and the cost of a single leater belt of this span, and six inches wide, would be about $19. The opposite fault, that of too slack belts, is also to be avoided, particularly in long spans, as it will cause flapping and swaying of the belt. A very marked case of this kind came to the writers notice in this way: A neighboring factory had recently put in a new span of some 40 or 50 feet. The belt stretched so as to sag nearly 16 inches, and the slack side swayed laterally with an even, regular swing, corresponding with the vibrating length of the building, and imparting its motion to it, so that the whole system of timbers swayed in unison. This would have soon loosened every joint and nail in the building had it been allowed to go on. The remedy which I prescribed was to take up the belt until it sagged only six inches, and then to support both top and bottom sides of the belt with an idler.

To sum up the evel of errors in the design of systems of shafting we notice first, errors in the alignment of the shafting and in the spacing of hangers and pulleys; and second, errors in the adjustment of the bearings, in the size of the pulleys and in the tension of the belts. Lubrication I will leave others to discuss. All these errors add to the useless expenditure of power, and consume time and labor in keeping things in good oader. That "time is money" every one knows. —[Paper read before the Engineer's Club, Philadelphia.]

THE convention of the street railway men in Cleveland was a splendid success. The exhibits were very interesting. Special mention of some of them will be found elsewhere in this issue.

THE cholera scare seems to have died out. The political agitation soon follows it, and then the country will get down to business.

METAL-CUTTING TOOLS.—II.

CUTTING-OFF TOOLS.

The cutting-off tool, as its name implies, is used for cutting off ends or lengths of shafts, bars, etc., and also for squaring collars, shoulders and ends from which considerable stock is to be removed. As it is a very troublesome tool to use unless properly made, it is important to see that all essential features are carefully provided. The most common difficulties experienced are of a directly opposite nature and cause, though of like effect. With even the greatest care in feeding, the tool will catch and dig into the metal, causing the shaft to spring and climb the point, with the usual result of a broken tool or center, or both, and a bent shaft—the latter, not infrequently, being thrown completely out of the lathe.

The greatest care is necessary to see that proper clearance is provided—neither too much nor too little, as either will cause the troubles described. The cutting edge should be on the end only, and be set parallel with axis of the lathe. The clearance under it must be made, like that of the diamond point, solely with reference to the vertical tangent, and of from one to two degrees angle. Also, it should be straight from the point or edge to the heel, as the very common practice of grinding it hollow to the curve of grindstone or emery-wheel face is one of the very best methods of rendering the degree of clearance an unknown quantity.

With proper clearance, unless the edge be very dull, the tool itself seems to regulate the feed (for ordinary engine-lathe work cutting off is generally done by hand and not power feed), and all that is necessary for the operator is to turn the screw sufficiently to follow the tool. The reason is simply that that the tool, below the edge, bears against the work under the cut, and the depth of the latter is gauged and controlled by the degree of clearance. As soon as any necessity for forcing the tool to the work is felt on the feed screw it is a sure indication that the edge is dull and in need of grinding. Any attempt to continue its use after this is at the risk of trouble. The next feature to consider is that of side clearance—that is, the blade or working part of the tool should be a uniform taper back from the cutting edge, as far as the length of the blade is likely to be reduced by grinding, and from this point back to the shoulder it may be made straight if desired. This side clearance should be equal on the two sides, more with reference to the setting or plane of rotation than with the cutting edge, as it is not necessary that the latter be set exactly parallel to axis. It is a very common practice with lathe hands to gauge the side clearance with the caliper, by making the blade thinner at bottom. This, however, is misleading, as the clearance of the two sides cannot be considered with reference to each other, but to the setting of the tool. For instance, the caliper may show ample taper, and yet, when the tool is set, it will be found to bear so hard below the edge on one side as to prevent the latter from touching, while on the other side we find all the clearance intended for both. The reason is obviously to be found in the fact that the blade and body of the tool are not parallel with each other, and as the latter is what determines the position of tool with relation to the rest, the blade must, of necessity, stand on a skew. A very simple and much the best way to gauge this clearance is by setting the tool by the bottom of body on a plane surface, and trying the two sides with a small square, or the ordinary four or six inch scale stood on end will answer, if held carefully perpendicular.

The practice of grinding a lip or hook point on the tool, while undoubtedly giving it a good cutting point, is not at all necessary and is objectionable from the fact that it affects the shape of the point, giving it a different angle after each grinding and also lowering the point with reference to the body of the tool. In cutting off bars or shafts, or in any deep cutting, the position of the tool as to hight of point must necessarily be changed in order to keep the clearance correct. This is owing to the constantly decreasing size of circle to which the tool must be kept approximately tangent, as previously stated. The operator can tell without difficulty when the change must be made, as the action of the tool is felt to a wonderfully accurate degree on the handle of feed screw. Just as soon as there is the slightest indication that the feed is becoming less free and requires an increased effort to make it cut, the lathe should be stopped and tool point lowered, otherwise the forcing may be continued until it results disastrously. The nearer the center of shaft is approached in the cut the more the danger of catching, and the more care is necessary.

One very common cause of trouble, even with a tool perfectly correct as to form and setting, is from seams and sand streaks liable to occur in ordinary merchant bar iron. The effect is to dull the tool and also to offer a hard spot in the cut, over which the edge will spring until the resistance is sufficient to force it in by main strength, when it is almost sure to catch. The only effective remedy is to stop the cut, run the edge back from contact with the work, and with a cape chisel the width of the tool edge, chip out the spot as deeply as convenient and resume the cut. This must be repeated as often as necessary until the streak is passed or the required depth of cut is reached.

Except for heavy tools, the use of water in cutting off is not advisable, as it increases the tendency to catching. Ordinarily the tool will work all right on a dry cut, but if, for any reason a lubricant is required, oil should be used, preferably of the quality used on bolt cutter. Properly made and set, the use of the cutting-off tool is no more difficult or troublesome than any other form.—[Iron Age.]

(To be continued.)

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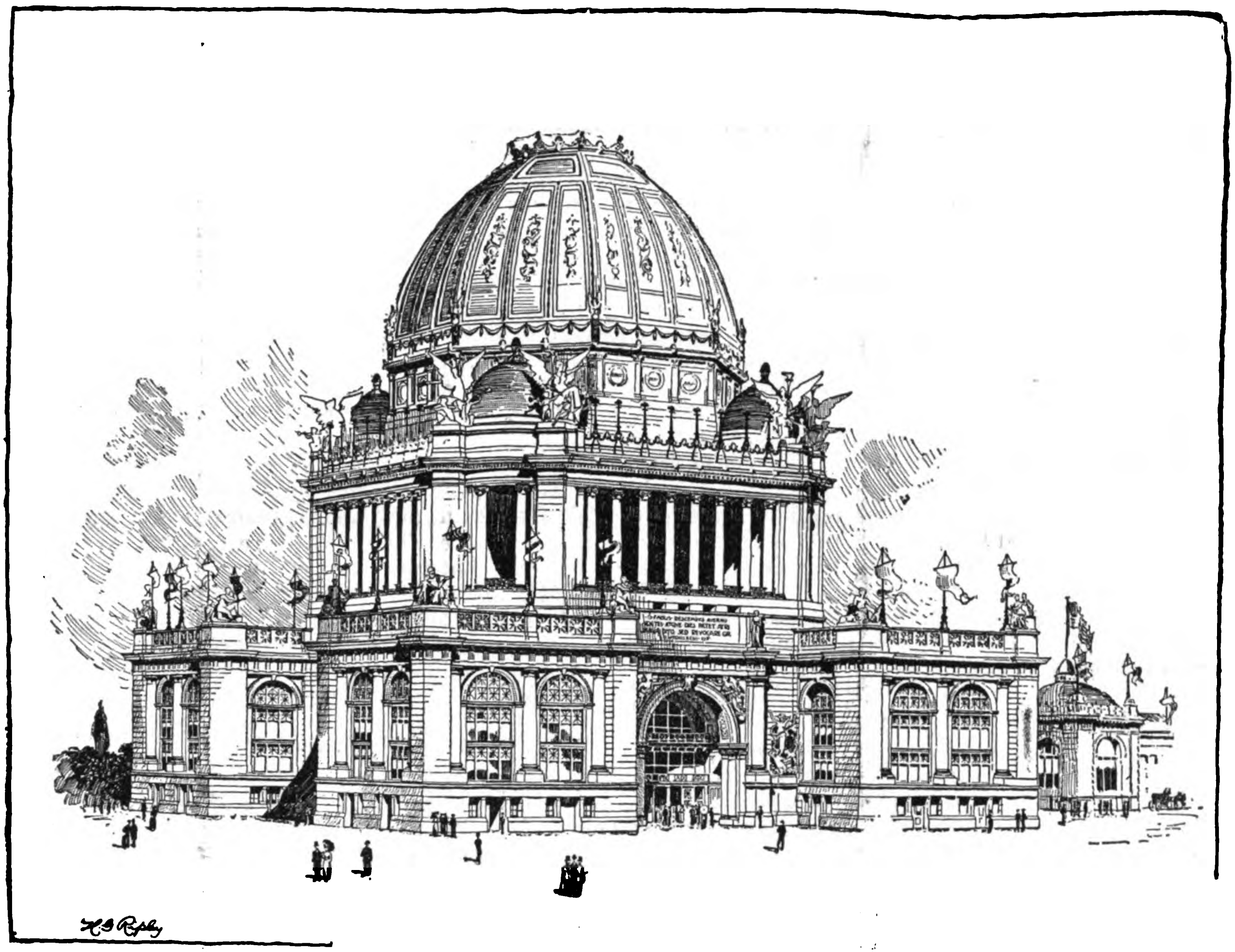
THE fall weather has been so faultless that the approach of winter could scarcely be realized. But it is time to prepare for cold weather. Delay will only render such preparation the more difficult.



ADMINISTRATION BUILDING, WORLD'S FAIR.

DANGERS OF AMMONIA.

BY PROF. W. K. BURTON.

The author says in Photographic Work: I protest against the very strong ammonia made particularly for photographic work, because of its highly dangerous nature, because such ammonia is always of very uncertain strength a little time after the bottle has been opened, on account of its great volatileness, and because there is so slight an advantage in this exceeding concentration.

The following accident has twice happened with the writer: A bottle of ammonia was opened. For a few seconds nothing took place, but then suddenly ebullition began at the bottom of the liquid, and three-quarters of the contents of the bottle were violently discharged against the ceiling of the room. The force of discharge may be judged when I say that in one case the room was thirteen feet high and the bottle was on the floor when it was opened.

In neither of these two cases was there any serious result. In one (the bottle holding half a gallon), the occupants of the house had to take to the street, and could not enter the house for some half hour or so.

I have, however, recently heard of a case where the contents of a bottle of ammonia discharged themselves as I have described, and a part of the liquid being blown into the eye of the operator, he totally lost the use of that organ.

In England this very strong ammonia is bad enough, but in climates where the weather is sometimes hot it is much worse. With the thermometer above 90 degrees F. in the shade I would much rather handle nitro-glycerine than "0.88 ammonia."

And how small is the gain from this extreme concentration! Why was it ever necessary to have a stronger ammonia than the liquor ammoniæ fortier of the British Pharmacopœa? The specific gravity of this ammonir is 0.891, it contains only about 10 per cent. less actual ammonia than "0.88 ammonia," yet is far less dangerous.

I should, however, strongly advise the adoption of ammonia of 0.9 specific gravity as a standard for photographic purposes. Such a liquid contains about 20 per cent. less ammonia that "0.88 ammonia" (involving an increase in the quantity of solution used of one quarter, or 25 per cent.) It is much less liable to lose strength by volatilization, and it is not nearly so dangerous as the very concentrated ammonia made for photographic purposes.

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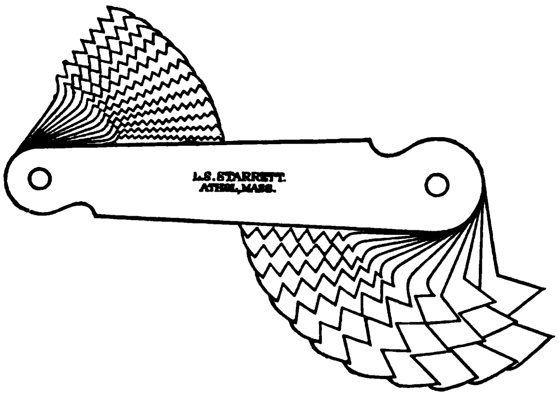
STARRETT'S NEW SCREW PITCH GAUGE.

L. S. Starrett, Athol, Mass., in response to many inquiries for a screw pitch gauge with coarser pitches than those in his well-known No. 40 and No. 11½ gauges, is now making one with the following pitches: 4, 4½, 5, 5½, 6 7, 8, 9, 10, 11, 11½, 12, 13, 14, 15, 16, 18, 20, 22, 24, 26, 27, 28, 30. The teeth are sharp and clean cut. Like his No. 40 and No. 11½, it is a reliable gauge by which to grind and test a threading tool at 60 degrees, and is especially convenient for an inside tool. The price is $1.25.

The illustration represents the full size of the gauge.

Mr. Starrett informs us that another new gauge, with pitches from 42 to 84 will be ready soon, and further particulars, circuliars, etc., may be had by addressing him.



STARRETT'S NEW SCREW PITCH GAUGE.

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SOMETIMES there comes back to the shop a bearing that will heat, no matter how much oil it gets. It is strange, but true, that in such cases relief will very often be got by simply changing the bearing metal. If it is a brass bearing that heats, a babbitt bearing will often work all right, and this with no discredit to the brass, because it is very often just the other way about; the brass will run cool where the babbitt will melt out. No one as yet can tell just why this is in any one instance; there are about seventeen different things that go to make up the reason or the set of reasons why the thing will not run cool. Just put it down to the nature of the beast, and try something else. I have known apple wood to run cool where babbitt and brass both failed, and vice versa.

BEARING METAL ALLOYS.

The common metals from which alloys are made for bearings may, perhaps, be enumerated as follows: Copper, tin, lead, zinc, antimony, iron and aluminium. It is, of course, possible for manganese, silicon, bismuth, mercury, cadmium, nickel, cobalt, sulphur, arsenic and phosphorus to occur either as essential or accidental constituents of bearing metal alloys. The last two are not rare, and are purposely used. The combinations of those are quite numerous and it will be observed that the possibilities of combination are very great. There is not only the different kinds of metal, but the different proportions. During my experience, now of some fifteen years, there have been analyzed in the laboratory of the Pennsylvania Railroad Ccmpany, a good many bearing metals under various names, and for the sake of record some of these analyses are given as follows:

CAMALIA METAL.

	Per Cent.
Copper	70.20
Tin	4.25
Lead	14.75
Zinc	10.20
Iron	0.55

ANTI-FRICTION METAL.

Tin	98.13
Copper	1.60
Iron	trace

WHITE METAL.

Lead	87.92
Antimony, by difference	12.08

METAL FOR LINING CAR BRASSES.

Lead	84.87
Antimony	15.10
Tin	trace

SALGEE ANTI-FRICTION METAL.

Zinc	85.57
Tin	9.91
Copper	4.01
Lead	1.15

GRAPHITE BEARING METAL.

Lead	67.73
Tin	14.38
Antimony	16.73
Iron	not determined
Graphite	none

ANTIMONIAL LEAD.

Lead	80.69
Antimony, by difference	18.83

CARBON BRONZE.

Copper	75.47
Tin	9.72
Lead	14.57
Carbon	possible trace

CORNISH BRONZE.

Copper	77.83
Tin	9.60
Lead	12.40
Zinc	trace
Iron	trace
Phosphorus	trace

DELTA METAL.

Copper	92.39
Tin	2 37
Lead	5.10
Iron	0.07

MAGNOLIA METAL.

Lead	85.55
Antimony, by difference	16.45
Traces of iron, copper, zinc and possibly bismuth	

AMERICAN ANTI-FRICTION METAL.

Lead	78 44
Antimony	19.60
Zinc	0.98
Iron	0.65

TOBIN BRONZE.

Copper	59.00
Zinc	38.40
Tin	2.16
Iron	0.11
Lead	0.31

GRANEY BRONZE.

Copper	75.80
Lead	15.06
Tin	9.20

DAMASCUS BRONZE.

Copper	76.41
Tin	10.60
Lead	12.52

MANGANESE BRONZE.

Copper	90.52
Tin	9.58
Manganese	none

AZAX METAL.

Copper	81.24
Tin	10.98
Lead	7.27
Phosphorus or arsenic	0.37

ANTI-FRICTION METAL.

Lead	88.32
Antimony	11.93

HARRINGTON BRONZE.

Copper	55.73
Zinc	42.67
Tin	0.97
Iron	0.68

CAR BOX METAL.

Lead	84.33
Antimony	14.38
Iron	0.61
Zinc	trace

HARD LEAD.

Lead	94.40
Antimony	6.03

PHOSPHOROUS BRONZE.

Copper	79.17
Tin	10.22
Lead	9.61
Phosphorous	0.94

EX. B. METAL.

Copper	76.80
Tin	8.00
Lead	15.00
Phosphorus	0.20

It will be understood that the above analyses represent many metals offered by many different parties, sometimes under the same name. These analyses are selected from the many that have been made in the laboratory of the Pennsylvania Railroad, during the last twelve or fifteen years, and are simply put on record for whatever value they may have. It will be observed that copper, tin, lead, antimony and zinc are the common metals used, and that iron is not a rare constituent. In some cases where there were very small amounts of other metals they have not been determined, and sometimes may fairly be regarded as impurities. At other times perhaps there are essential constituents. I know of one or two cases where this latter is claimed, but our experiments have not gone far enough to prove whether these small amounts of other constiuents are of value or not. On the other hand it is well known that a small amount of iron imparts to a copper-zinc alloy quite wonderful properties. In the case of the so-called Harrington bronze, the analysis of which is given above, the alloy after it had been rolled, actually had a tensile strength cf 75,000 pounds per square inch, and an elongation of about 20.00 per cent. in a two-inch section. Quite a number of other alloys have either been examined qualitatively, or put on trial during the last fifteen years. Aluminium bronze has not yet been tried, but it is now under considera tion.—C. B. Dudley, Ph. D., in Journal Franklin Institute.

BOOKS AND CATALOGUES.

"HOW TO BECOME AN ENGINEER," is the name of a little book by Geo. W. Plympton, published by D. Van Nostrand, N. Y. It relates to civil engineering, and reviews the theoretical and practical training necessary to learn this profession. The work has every appearance of being an excellent one on this subject.

"PRACTICAL DYNAMO-BUILDING FOR AMATEURS," by Frederick Walker, published by D. Van Nostrand, 23 Murry St., N. Y., is a work that many mechanics will find useful. Its price is 50c.

"TRIPLE-EXPANSION ENGINES AND ENGINE TRIALS," by Prof, Osborne Reynolds, will be found a useful work of reference. As a treatise on three-cylinder engines it is very meritorious. It is one of the 50c. series of popular mechanical books published by D. Van Nostrand & Co., whose address is given above.

"DYNAMOMETERS AND THE MEASUREMENT OF POWER: A treatise on the construction and application of dynamometers, witb a discription of the methods and apparatus employed in measuring water pressure; by John J. Flather; published by John Wiley & Sons, 53 E. 10th St., N. Y."

This is a work of 215 pages, comprising very valuable information an the subject treated. In the first chapter the "determination of driving power" is discussed; in the second, "friction-brakes;" in the third "absorption-dynamometers," are dwelt upon and in the fourth "transmission-dynamometers;" power required to drive lathes," takes up the fifth, and the last is devoted to "measurment of watar-power."

"PRACTICAL CARRIAGE BUILDING. Edited by M. T. Richardson, editor of 'The Blacksmith and Wheelwright' Illustrated. Vol. 11. Cloth, $1. M. T. Richardson Co,, Publishers, New York."

The first volume of this work was recently noticed in our columns. Beginning with information regarding axles, volume II considers in detail the plumbing of spokes, gather of wheels, making yokes and whiffletrees, laying off a fore carriage, special tools, making ovals, blocking corners, making and laying off patterns, and drawing of tools. Complete instructions regarding the laying off and framing of carriage bodies, construction of carriage parts and wheels, light and heavy sleighs are given. The book is profusely illustrated, and printed and bound uniform with the first volume.

Novel Measuring of Water Depths.

"About two years ago," says Frederick J. Smith, of Trinity College, Oxford, in Nature, "I wished to know from time to time the rate at which a river was rising after a fall of rain. The river was a considerable distance from the spot where its height was to be known. By means of the combination of two organ pipes and a telephonic circuit I was enabled to make the required measurement within rather close limits. At the river station an organ pipe was fixed vertially in an inverted position, so that the water in the river acted as a stopper to the pipe, and the rise or fall of the water determined the note it gave when blown by a small bellows driven by a very small water-wheel.

"A microphone was attached to the upper end of the organ pipe; this was in circuit with a wire leading to a town station at some distance; at the town station there was an exactly similar organ pipe, which could be lowered into a vessel full of water while it was sounding. By means of the telephone the note given by the pipe at the river was clearly heard at the town station; then the organ pipe at this station was lowered or raised by hand until it gave the same note. The lengths of the organ pipes under water at the two stations were then equal, so that the height of the water in the distant river was known.

"The determination can be made in less than a minute by any one who can recognize the agreement of two similar notes. The arrangement when first tested was so placed that the height of water at two places near together might be easily compared. I found that a lad with an average ear for musical sounds was able to get the two heights to agree within one-eight of an inch of each other, while a person with an educated ear adjusted the instrument immediately to almost exact agreement. The total height to be measured was 17 inches. A difference of temperature at the two stations would make a small difference in the observed heights. For instance, taking a note caused by 250 vibrations per second, a difference of 10 degrees C. between the temperature of the two stations (one not likely to occur) would make a difference of about 0.02 feet in the height—a quantity of no moment in such a class of measurements. The organ pipes were of square section, and made of metal, to resist the action of water."

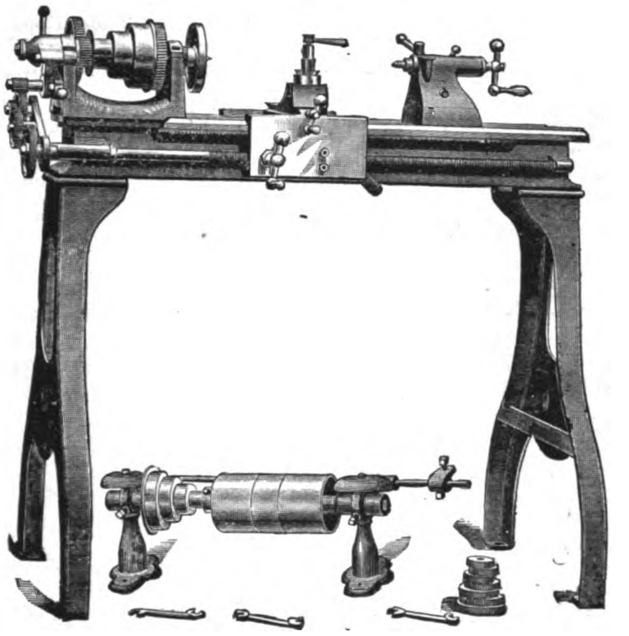
◆ ◆

Now that Judge Gresham has decided that Chicago tugs can not burn soft coal, the tugmen are casting about for a new fuel. A party of them recently went to coal mines near Pittsburgh to make experiments on coke. To make coke serviceable on tugs it is necessary to remove less of the volatile products than is ordinarily done. The coking process must be shortened. At the mines one of the ovens was filled with soft coal of the poorest quality and kept burning 10 hours. It was then tested, but found to produced too great a heat. The coking in another oven was stopped at the end of 4½ hours. This burned readily without too much heat and almost entirely without smoke. The tugmen believe, it is claimed, that they have discovered a fuel which will meet all the requirements.

TEN-INCH ENGINE LATHE.

The illustration represents a 10-inch engine lathe, well known in the market, from the shops of The Sebastian-May Co.

The lathe has a three-speed cone for a belt 1½ inches. They are 2½ inches, 4 inches and 5 inches in diameter. The front bearing of the spindle is 2¼ inches long and 1 5-16 inches in diameter, and there is a hole 1½ inches entirely through the spindle. The back gear is thrown in and out by a cone. By reversing the gear in the head stock right and left hand threads may be cut. The lathe swings 6½ inches over carriage.



10-INCH ENGINE LATHE.

The lathe is built either with foot motion or countershaft.

This is a very durable tool, well finished. The builders make other sizes, larger and smaller. A more complete description of this and particulars concerning the entire line may be had by addressing The Sebastian-May Co., Sidney, O.

Where to Locate New Factories

Is the title of a 150 page pamphlet recently published by the Passenger Department of the Illinois Central Railroad, and should be read by every mechanic, capitalist and manufacturer. It describes in detail the manufacturing advantages of the principal cities and towns on the line of the Southern Division of the Illinois Central and the Louisvllle, New Orleans & Texas Railroads, and indicates the character and amount of substantial aid each city or town is willing to contribute. It furnishes conclusive proof that the South possesses advantages for the establishment of every kind of factory working wool, cotton, wood or clay. For a free copy of this illustrated pamphlet address Mr. J. F. Merry, Assistant General Passenger Agent, I. C. R. R., Manchester, Iowa.

Burlington Route New Service.

A through Pullman sleeping car, Chicago to San Francisco, is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11:45 A. M., less than four days en route.

Through Train Service.

It is with pleasure that we announce to the patrons of the Nickel Plate that on and after October 17th, their train No. 1 will leave Buffalo daily, except Sunday, at 12 o'clock noon and run through to Chicago, via Erie, Conneaut, Ashtabula, Geneva, Painesville, Cleveland, Lorain, Bellevue, Fostoria, Fort Wayne and Valparaiso, arriving in Chicago 8 o'clock the following morning. Also that train No. 2 will leave Chicago daily, except Saturday at 10-10 P.M. and run through to Buffalo stopping at points named adove, arriving in Buffalo at six P. M. the following day.

Elegant Wagner Buffet sleeping Cars will be run on both trains.

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Hereafter it will not be necessary to change cars in going from Buffalo to Chicago, or vice versa, as the Nickel Plate will have through train service in both directions. Every through train will be provided with Wagner Buffet Sleeping Cars. See time card.

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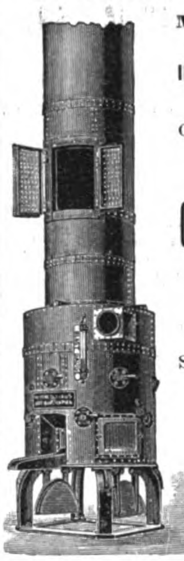

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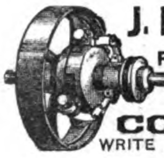

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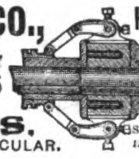

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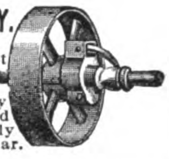

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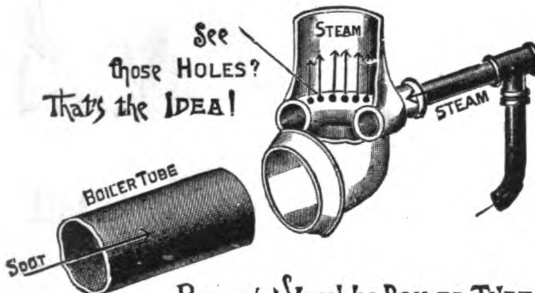
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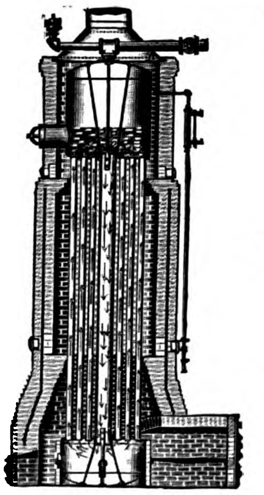

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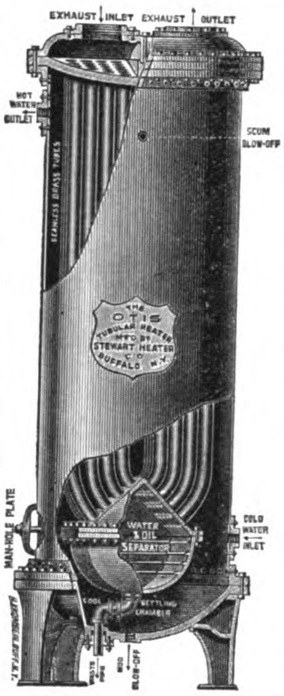

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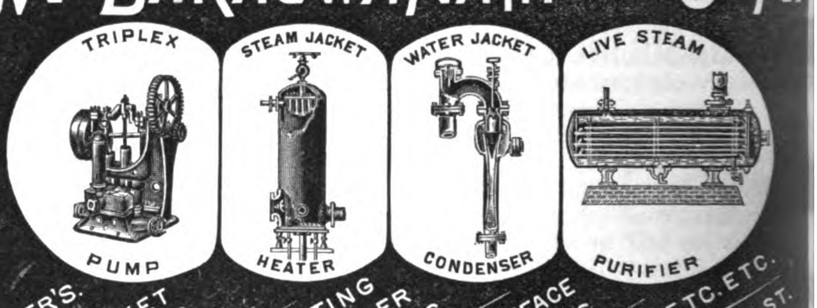

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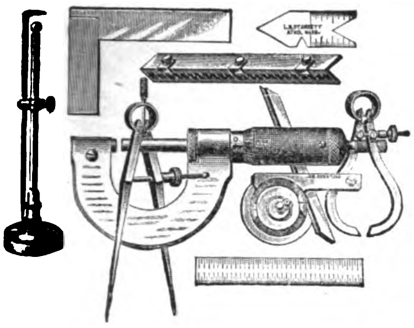

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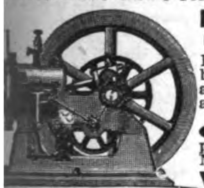

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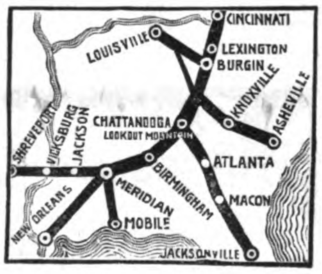

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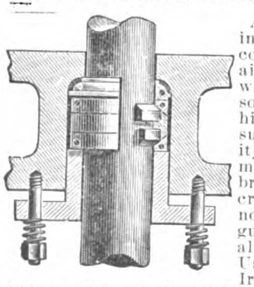

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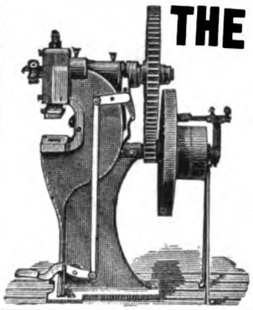

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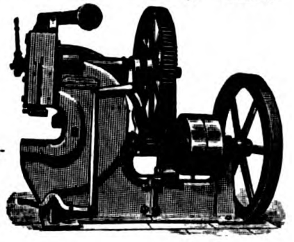

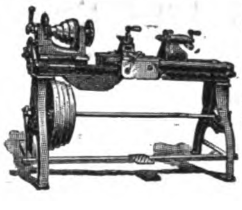

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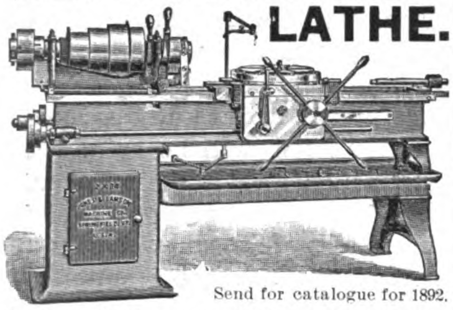

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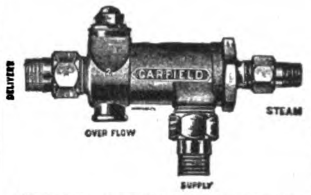

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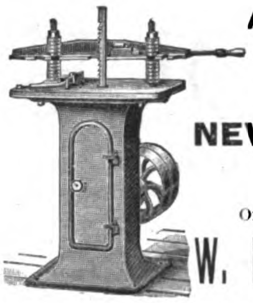

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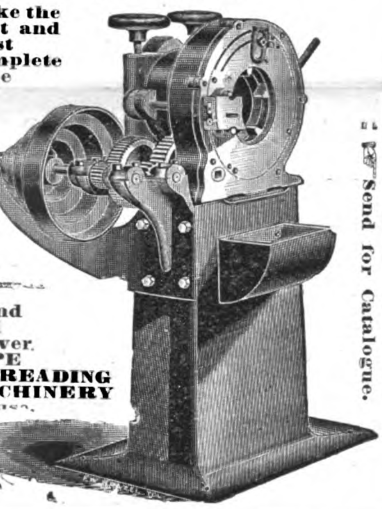

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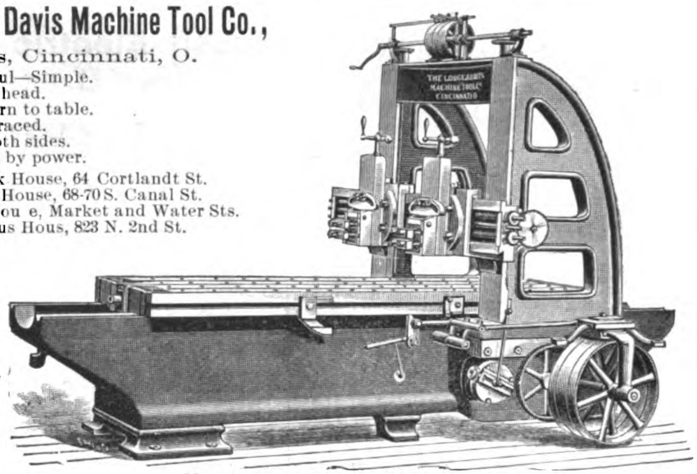
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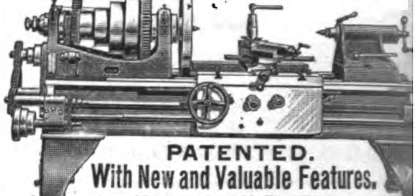

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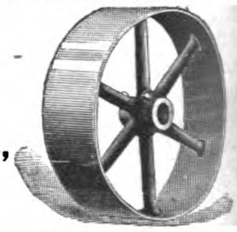

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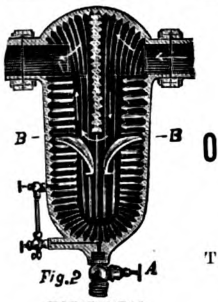

Fig. 2
HORIZONTAL.

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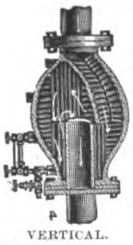

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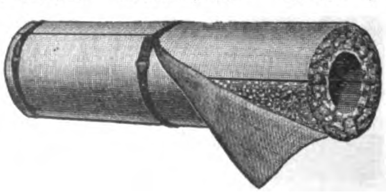

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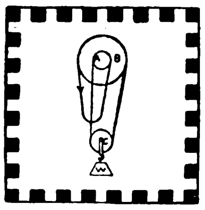

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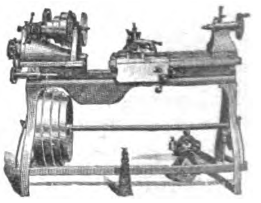


SCIENTIFIC MACHINIST

EVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOS

STABLISHED 1882. CLEVELAND, O., NOVEMBER 1, 1892. Vol. 10—No. 21. Published Semi-Monthly. Sold by Newsdealers. Terms:—$1.50 A Year. Single Copies, 7 Cents.

METAL CUTTING TOOLS.—III.

INSIDE WORK ON THE LATHE.

For inside work on the lathe there re several points in which the genral principles of form and use of he tools are radically different rom those for ontside work. The angency of setting, for instance, is mpossible, as a tangent to the inide periphery of a hollow cylinder ust necessarily fall within the ody of metal forming the walls. onsequently the clearance and seting must be considered with refernce to the periphery itself. The mount of clearance, of course, canot properly be expressed as an ngle of so many degrees, but as he tool should form a circular arc, ccentric with relation to that of the ylinder, the degree of eccentricity ay readily be considered as an anle of the required number of derees by imagining the diverging rcs to be straight instead of curved ines. This necessarily involves a niform degree of divergence; but f the two arcs be truly circular, the oint of uniformity takes care of itelf. For instance, we will assume hat the proper height for the point f the tool is on the horizontal line f axis of the cylinder, and that the mount of clearance necessary is the ame as would be required on outide work, say 2° from the vertical angent. In order to obtain an exct equivalent clearance for the inide surfaces the following method f constructing a diagram will illusrate more clearly than would be ossible by a mere description:

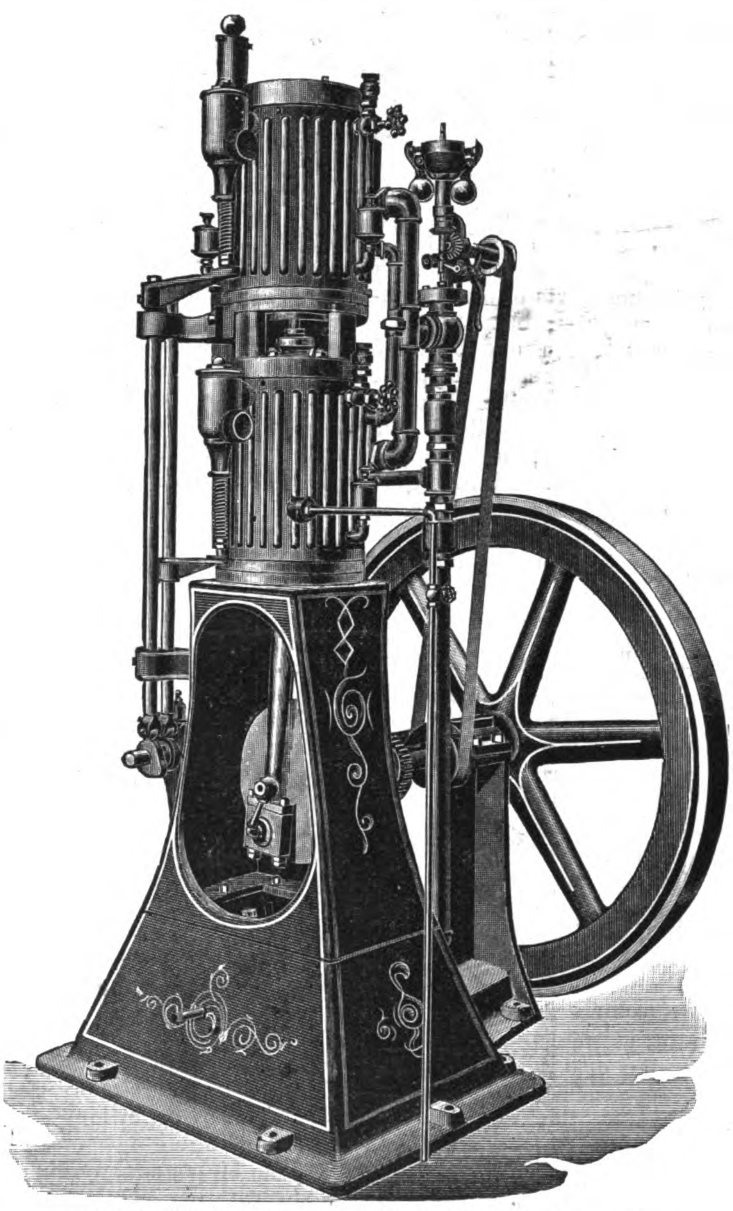
Lay out with the dividers a circle f the diameter of the inside surface f the cylinder at the bottom of the ut. From the center toward the eft hand side of the periphery (reresenting the side on which the ool would be set) draw a horizontal adius, and a second one as far beow the former as will approximate he position of the heel of the tool. Now, 2° below the second radius raw a third one, and, by setting the ividers by the chord of the arc conained between the first and second adii, transfer the measurement from he center of the circle to scribe an rc between the second and third ralii. The chord of this 2° arc should hen be transferred by the dividers o the second radius, measuring in oward the center from periphery. Lastly, erect a radius perpendicular o horizontal one upward, reset the ividers to full radius of circle, place ne point at intersection of small rc, representing the degree of clearance with second radius, and scribe across the last or vertical one. This intersection will be the center from which to describe the eccentric arc, representing the shape of tool from point to heel, to give the 2° clearance required. If the assumed 2° clearance be correct, then the tool should work at its best, both theoretically and practically.

It will be seen that with the inside as with the outside tool, the height of the tool with reference to that of the lathe center is entirely immaterial as regards its correct cutting properties, but for the same reason as given in describing the latter, the best position for point will be very little, if any, below the height of center. Of course it will not be necessary to lay out the diagram described except in the one instance, in order to obtain an idea of the correct principles involved in so important an operation. It is safe to say, however, that the geometrical demonstration of this, as of any other subject capable of such expression, will give a clearer and more correct understanding of the requirements than can be possible in any other way, no matter how carefully considered.

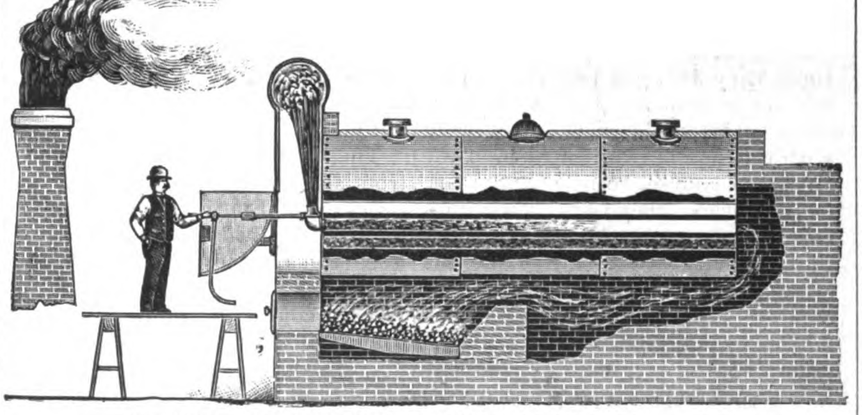
Having determined this clearance, it is only necessary to say with reference to side clearance that there being no difference in the operation of this tool from that of the outside one, the rules given for the latter are equally applicable to the former. The angle of top face with relation to point and side edge should also be made similar; likewise the width of straight portion of point to insure smooth turning and avoid deep tail marks. Much better work, as well as quicker time, can be made by using a quick feed and rotative speed to suit, than by the very common practice of quick speed and slow feed. This, of course, will be understood as referring to roughing cuts only; for finishing cuts the quick speed is generally correct. For inside work the tools are more often made and set wrongly than correctly, as can be seen by examining those on the tool boards of the average lathe hand. Many of them are made with any sort of excresence on the cutting side, which is made to do duty for the point. As they are devoid of any such matter as clearance the setting is made to conform to their peculiarities of form, and that is usually very high above the center, so that the metal is dug, scraped or torn off, and instead of being long and curled, the chips fall from the work in a granular or pulverent form. That it is impossible to bore or turn a true surface, either round or straight, with such a tool, must be readily apparent to anyone who has his mother-wit, for surely no technical knowledge should be necessary to enable him to see it.

The difficulties of inside turning are much greater for bores of small diameter than for large, as it is impossible to see the operation of the tool after it has entered the hole for an inch or two; and, therefore, the only way of judging whether or not

(Continued on page 12.)



THE HICKS GAS AND GASOLINE ENGINE.—(See page 12.)



BALDWIN'S VACUUM BOILER TUBE CLEANER.—(See page 12.)

ELECTRICAL

Some Anomalies in Dynamo Design.

It is frequently stated that no one can design a dynamo who is not a trained engineer. If this be the case, dynamos must be in rather a backward state, for very few dynamos are nominally designed by engineers. On the other hand, an eminent and very successful dynamo maker has said that a "cow of average intelligence could design two bearings, and that is all the engineering there is in a dynamo." Probably the truth lies between these extemes. There is not much engineering construction in a dynamo, and in most cases the machine bears the name of this or that electrician, while all the engineering details are worked out by experienced draughtsmen, who get little or no credit for their work.

Some years ago the complaint was made that dynamos were mechanically bad. The armatures were mounted on wooden hubs, and the machines looked as if they had been made by an optician. Now we are going to the other extreme. In order to appear "a thoroughly mechanical piece of work," a dynamo is made with a ton or two of extra cast iron parts having stresses in pounds, but made heavy enough to stand pulls of many tons. The most serious forces in a dynamo are the magnetic pulls of the fields on the armature or on one another, but these receive very little attention. Few dynamos are designed to take these pulls fairly, and their value in pounds or tons is very seldom worked out. The air space in many dynamos decreases visibly when the field is excited. Still these pulls are steady and not intermittent, so little harm is done, though badly designed machines have come to grief from this cause. It is now the proper thing to admire a large, clumsy dynamo, on the ground that it is "a good solid mechanical machine." At the recent Crystal Palace Exhibition, any machine that was big and imposing as a structure had an admiring crowd round it. No inquiries were made as to what its output was or what it cost. If it weighed 20 tons and gave 20 kilowatts all would be quite satisfied and delighted. A very small machine is not necessarily cheap to make or good to work, generally the reverse; but a machine that is too large for its output is also always bad and expensive. The most common method of making a dynamo into a "good solid piece of engineering" is to develop its bed-plate to an abnormal extent. But the only important stresses in a dynamo are internal; the motion is steady, and the other forces in the machine are insignificant. It is, therefore, unnecessary to mount the machine on an extensive substructure of hollow cast iron work. Many modern dynamos look as if their designers thought they would bend unless carefully secured to good solid foundations of rock by means of ample castings capable of withstanding the enormous stresses derived, persumably, from the belts or ropes. The illusion is generally entirely spoilt by hoisting the whole thing on two little slides, so as to admit of tightening the belt. There are many odd sights in electric stations and installations, but few are stranger than a dynamo with a ponderous bed-plate mounted on foundation rails. If the machine is designed to be used on foundations rails, the bed-plate might be omitted, and full provision made for the dynamo to rest on the foundation rails, but it should not look as if it were trying in vain to sit down upon a large area, but could not reach the ground. If a casting is needed to form the framework of the dynamo, it should be arranged as a frame, and not as a bed-plate, and it might be designed much in the same way as the entablature of a paddle-wheel engine.

Any good impression that might be made by the imposing amount of cast iron in a modern dynamo is sadly weakened by the eyebolt with which an electrical engineer always crowns his work. The eyebolt suggests that the dynamo may break down at any instant, and can be whisked off—if such an expression can be used without disrespect to the bed-plate—and replaced by another at a moment's notice. The electrician's eyebolt is almost unique. Cylinder covers, piston rods, and other parts of marine engines have eyebolts; but they are inserted and taken out by hand when the vessel comes into port. Engineers do not provide eyebolts in other cases. The boilers of a steamer, for instance, are dropped in without difficulty, and an engine maker does not send out, say, a hundred-horse stationary engine all in one piece with an eyebolt, so that it can be lifted like a dynamo or a lady's parcel. In spite of its odd appearance the eyebolt has some advantages. But the money spent in making it, and carefully polishing it all over—a most essential process it would seem—can hardly be saved in reduced cost of carriage, due to ease of lifting in those cases where sufficiently powerful cranes are in use.

Few dynamos appear as if complete drawings had been made before building. Apparently the drawing office gets out the frame of the machine and some other department winds on the wire. The erectors at last find that there are a number of connections to be made, and the appearance of the machine is spoiled by the addition of rods and bars of silk-taped copper straggling about in all directions. The terminal board is screwed on wherever there is room for it, having apparently been forgotten when the machine was designed. The windings, except in rare cases, are left exposed. Sometimes they are painted red. This is a survival of the days when opticians painted electrical apparatus with red sealing wax varnish. They ought, of course, to be covered in. In America they are sometimes roped, but rope is a bad conductor of heat. Besides, a dynamo has already so much paper, cotton, vulcanized fibre, string and other materials suggestive of postage-stamp edging and sealing-wax, that it is a pity to use rope when metal can be employed.

After a few year's work most dynamos are saturated with oil. This is due to the design of the bearings not being thoroughly worked out. The drawing office designs a bearing, and the machine is sold, and nothing more is heard of it until the insulation breaks down, and it comes back to be re-wound; but even then nothing is attributed to the bearings. This is one of those cases—common enough in engineering—of want of touch between the makers and users of machinery.—London Industries.

Development in Electric Metal Working.

BY FREDERICK P. ROYCE.

In the year 1888 the electric welding process was first practically applied to commercial work. Machines were rapidly built for various purposes and welding plants were soon established in various large works throughout the country, for a great variety of purposes.

Iron, steel, copper or brass wire of various sizes are united into long lengths; rods and bars of iron and steel are welded, shaped and forged by electrical heat; axles, tires, small parts of carriage and wagon work are turned out in large and rapidly increasing quantities; tubes of iron or steel are welded together in lengths of several hundred feet, and bent into spirals or oblong coils of sizes and shapes required; parts of bicycles are brazed or welded, as the case may be; iron agricultural wheels are welded spoke to hub and spoke upset to tire; fine grades of tool steel, as Mushet or Jessop's, are welded to machine steel, forming tool blanks, which may be used with great economy in all machine shops; lead composition plates are electrically connected for storage battery purposes; forgings of 10 square inches of section are heated by the welding process, and united by enormous hydraulic pressure; ship stanchions, rods and shafting are easily welded by powerful machines in our different navy yards, and the field is rapidly broadening for a greater variety of work, and with most satisfactory results.

The newly developed methods of producing aluminium, and the consequent decrease in its cost, promises to open a wide field for this process, as the metal can be welded easily and as quickly as either steel or iron.

Special machines have necessarily been built adapted to the requirements of these different grades of work. The conditions are constantly changing and welders varying from 50 pounds' weight to that of several tons are built as called for to meet the demands from various sources.

At the works of the Johnson Company, at Johnstown, Pa., several hundred large welds, in connection with their various forms of road-bed construction are made daily.

There 10 square inches of steel or iron are easily welded together, a pressure of 150 tons being supplied by heavy hydraulic appliances to reduce the burr or upset and finish the metal.

The complete welders are installed at their works, five of them for rail work alone, and weighing upward of 30 tons each.

The leading carriage and wagon manufacturers were the first in the field, and among those who then became interested in welding by electricity were Studebaker Bros. Mfg. Co., of South Bend, Ind.; Haydock Bros., of St. Louis, Mo.; the Parry Mfg. Co., of Indianapolis, Ind.; the Racine Wagon and Carriage Co., of Racine, Wis., and the Kentucky Wagon Mfg. Co., of Louisville, Ky.

They investigated the process thoroughly, and electric welding machines are now in active and successful operation in their shops. The Cleveland Axle Manufacturing Company, of Cleveland, O.; the Sheldon Axle Company, of Wilkes Barre, Pa., and the M. Seward & Son Company, of New Haven, Conn., were also among the first to instal apparatus.

Inquiries are constantly made as to the cost of electric welding in comparison with that of the older forge methods and it is to this important matter that it is desirable to give special attention in this paper.

There are two important elements that enter into the cost of welding: the labor required at the welder and the necessary power to drive the dynamo.

Regarding the labor, an engineer always employed in carriage and wagon factories can easily attend to the running of the dynamo. The machine is simple in its construction, it requires but very little care; it must be properly oiled, the brushes and collector ring kept clean, but beyond that needs little or no attention.

One man only is needed to operate the welder, where the pieces to be united are of regular shape, and the weight is such that they can be easily handled. In case great rapidity of work is essential, an assistant, generally a boy, will be the only additional helper required to facilitate the handling of stock.

In the case of axle work, two men are generally needed, a blacksmith to do the welding and a helper in reducing the burr or upset under hammer and in setting the axle, turning out easily 150 sets of 1" axles, or 100 sets of 1½" axles as the case may be.

In case of light iron buggy tires one man can easily weld from 70 to 800 daily with a helper, at low wages, to bring the stock to the machine and take it away. In the case of steel tires, 400 or 500 can be similarly welded. In heavy wagon tires somewhat more help is needed. At the Studebaker Works two heavy tire welders are placed side by side, with a hammer conveniently located, and a force of five men turn out a large product daily.

The smaller parts of carriage and wagon work are easily managed by a single operator. Fifth wheels, step irons, carriage rails, dash irons and other similar classes of work are turned out with great rapidity.

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The removal of the upset or burr at the point of welding is, of course, an element of cost and can be done in a variety of ways. Grinding was at first tried, but this was found to be too slow and expensive in connection with wagon work. Rolling was also attempted, but found to be impracticable commercially. Hammering has been found to be the cheapest and most effective method so far tried. All welds retain sufficient heat after they are removed from the welding machine to be hammered as much as may be required. Not only does the hammering reduce the burr to the size of the metal, but materially strengthens and improves the weld.

Various hammers have been designed working directly in connection with the welding machine, but with wagon and carriage work the ordinary light power hammer is found to be the most efficient. Either power or hydraulic presses have been found to be efficient in some varieties of work.

When welding apparatus was first introduced in carriage works, the cost of preparation of the parts to be welded was quite an item of expense. It was at that time thought best to remove all forms of oxide which might have accumulated on the steel or iron, but as this required both time and labor, it was speedily abandoned and it was decided to be more economical to increase somewhat the force of the current used for the welding, even at the expense of additional power required, and no preparation of the metal is now regarded necessary, as far as the ordinary oxide formed by the rolling of metal bars is concerned.

Should there be a heavy red oxide or serious accumulation of foreign matter it is best to remove this before the weld is made. It is frequently done by pickling, where large quantities of metal are to be cleaned cheaply, but it is only in exceptional cases where this is necessary.

The question of actual horse power required for welding both axles and tires has been carefully considered, and the following figures are based upon actual experience in various works and from very careful electrical and mechanical tests made by reliable experts :

1 in. round axle requires 25 h. p. for 45 seconds.
1 in. square " " 30 " 48 "
1¼ in. round " " 35 " 60 "
1¼ in. square " " 40 " 70 "
2 in. round " " 75 " 95 "
2 in. square " " 90 " 100 "

The slightly increased time and power required for welding the square axle is not only due to the extra metal in it, but in part to the care which it is best to use to secure a perfect alignment.

TIRE WELDING.

1 in. x 3-16 in. tire requires 11 h. p. for 15 seconds
1¼ in. x ⅜ in. " " 23 " 25 "
1½ in. x ⅜ in. " " 20 " 30 "
1½ in. x ½ in. " " 23 " 40 "
2 in. x ½ in. " " 29 " 55 "
2 in. x ¾ in. " " 42 " 62 "

The time above given for welding is, of course, that required for the actual application of the current only, and does not include that consumed by placing the axles or tires in the machine, the removal of the upset and other finishing processes.

From the data thus submitted the cost of welding can be readily figured for any locality where the price of fuel and cost of labor are known. —[Abstract of a paper read before the Buffalo Convention Chicago Builders' Association.

CUPOLA PRACTICE.

BY VICTOR COLLIAU.

(Answer to a Correspondent.)

A reader of the SCIENTIFIC MACHINIST asks a number of questions concerning cupola work, which the writer answeres as follows, the inquiries and statements of the correspondent being designated as, "C" and the answers and comment of the writer as "A."

C. We have a cupola 23 inches in diameter, (we suppose inside of lining) and we are melting from 15 to 28 hundred pounds of iron.

A. In order to know the performance of your cupola you must state how much time it took to make this melting, from the moment you had the first iron to the dropping of the bottom doors of the cupola.

C. We have always used coal for melting, but wish to use coke.

A. This is the best thing you can do.

C. How much coke should I use for a ton of iron, how much should be put in for the bed, (or first charge of coke,) then how much iron on it?

A. This depends on the quantity of iron you intend to melt in one operation. Always supposing that your cupola is built in good proportions, the bed (or first charge of coke), after the kindling wood has been ignited and almost burned out, should be three hundred pounds of coke and the charge made thus:

Bed Coke, ... 300 pounds.
1st charge of iron, 700 pounds.
Then coke, ... 50 pounds.
2d charge of iron, 500 " and 10 pounds lime stone.
Then coke, ... 50 pounds.
3d charge of iron, 500 " and 10 pounds lime stone.
Then coke, ... 50 pounds.
4th charge of iron, 500 " and 10 pounds lime stone.
Then coke, ... 50 pounds.
5th charge of iron, 500 " and:
Neither lime nor stone on the last charge.

Total iron, 2,700; lime, 30 pounds, Coke, 500 pounds

This makes 2,700 pounds of iron, melted with 500 pounds of coke, of which at least 50 pounds should be recovered after dropping bottom by throwing water on it and to be used for the melting of the next day.

This shows that the larger the melting the more economical it is. The bed (or first charge of coke) is always the same in the same size cupola.

C. How large or how heavy pieces should a cupola of this size be able to melt to an average?

A. The pig iron to be used in such size cupola should be broken in four pieces, the pigs weighing generally about 100 pounds, each piece to be about 25 to 30 pounds. The scrap iron used with it should be of about the same size, but if there were any heavier pieces, say 100 pound chunks, which could not be broken, put on the top charge at the loading door. Some coke should be put on and all around the large piece, which would follow the iron down the cupola to the melting point, which is a few inches above the tuyeres.

C. When using coke should I wait until the coke is all red (or nearly so) before putting in the iron ?

A. Have the tap and slag holes and all the tuyeres open, make a wook fire to reach one foot over the top of the tuyeres, then add coke gradually and in small quantity, a shovel full at a time, keeping it lighted and level 20" above the tuyeres ; then charge as indicated above and on the last charge of iron put no fuel.

It must be well understood that to obtain the results given the pressure of blast should always be about four ounces, maintained during all the time of the melting.

The blast should not be used before the cupola is full to the loading doors, and then not to be stopped but two or three minutes before dropping the bottom.

This pressure of blast of four ounces for a cupola of from 20" to 25" diameter inside of brick lining will be obtained with a Buffalo pressure blower No. 5, which is 26" high and making 3,000 revolutions per minute, requiring at that speed one-half horse power.

C. Some tell me to put iron in as soon as coke and put on blast.

A. You must not commence charging iron until the bed is well lighted and you should not put the blast on until the cupola is full to the loading doors.

For a cupola of from 20" to 25" in diameter, inside of lining, the loading doors should be 10 feet above the bottom plate.

To obtain a good draft and a good lighting of the bed the cupola should be 50 feet high above the foundation plate, though 60 feet would be better.

C. Does coke have a tendency to harden iron more than coal ?

A. No ; on the contrary, for the following reasons :

1. The iron is hardened in a cupola, if the fusion goes slowly. The iron being a long time exposed to the oxidizing influence of the air looses some carbon which was in combination with the iron ; the carbon being burned out, the iron becomes hard. With coke, the melting being much faster, the blast has less time to burn the carbon, so the iron remains soft.

2. The coke is made of coal by burning it partially. All the sulphur which may be in it burns out in the operation of coke making.

Sulphur has a great affinity for iron, and if there is any in the fuel it combines with the iron and makes it very hard and brittle. By using coke there is no such danger of sulphur. In coal there is often sulphur which, combining with the iron when melting, makes it hard. Coal requires more blast than coke to burn well and even with a stronger blast burns slower than coke. More blast means more expenditure of power and this means more expense. By burning slower it melts the iron more slowly, exposing it longer to the blast, burning more of its carbon and very often leaving some sulphur in its place, to the detriment of the iron.

THE Lodge & Shipley Machine Tool Company's motor gear lathes exhibited at the recent convention of the National Street Railway Association, at Cleveland, accomplished the remarkable preformance of turning, boring and squaring a motor gear 23 inches diameter, 4½ inch face and 3⅜ inch bore in 17 minutes. This machine is meeting with general favor, not only for motor gear work, but for general machine work.

"SHELL PATTERNS."—ENGINE BEDS.

BY J. LEON GOBEILLE.

Not very long ago it was the general pratice to make dry sand cores for almost everything. The simplest forms, like, for example, a pot with flaring sides, were so made by the best pattern makers. An iron pattern was seldom thought of, and even brass patterns were not used extensively, as all good patterns were of mahogany and made over again, when worn too much, for longer use. After a while all cast iron vessels were made lighter—a shell pattern being made by filling up a casting, and the work put up on a follow-board. The complications of plate work, especially stoves, during the past ten years have taught the pattern maker many things he might have know long before, had he taken the molder into his confidence instead of ignoring that important personage and knowing it all himself.

It is not necessary to points out the many lines in which this comparatively new idea has gradually got a fast hold. It is more interesting to discuss something that is going on right now—the change in practice regarding engine beds. Three years from now if an engine bed of ordinary size is made with a baked sand core, either your practice or your design will have to be changed. When beds for 10"x12" engines can be molded for $2.20 and irregularly shaped tangyes for $3.50, it looks as if the pattern maker would have to make some explanation when he sends out a cored pattern, and designers of engines look about them a bit and learn simplicity and not complexity in laying down their lines for cheap engines. The cheap engine is here to stay. For light powers, say under 50 H. P. and, with improvements in regulation, the plain slide valve is about as effective and economical as anything.

Let me tell you how a bright youngster in a country pattern shop made a shell pattern from the old fashioned kind. He rammed up the drag as usual, filled the center with old blocks and made a plaster cope. Then he rammed up a second nowel shaved off the sides and nearly vertical parts of his plaster cast, making all necessary changes to insure draft, raised the cope the thickness of metal desired, by means of strips of board around the parting and got a good casting the first time all ready to file up. The job took him two days with a molder to help him, and he saved a pattern expense of at least fifty dollars, besides 78 pounds weight of iron and $3.12 molding expense, on each bed made thereafter. Not so bad for an apprentice in a small pattern shop; but then he had brains and took a lively interest in his employer's business-qualities which are unfortunately lacking in some apprentices.

This is simply a hypothetical case put in this form to give some ambitious young man a hint. You can save money for your employer and thereby advance your own interests if you keep your eyes open and do a little thinking on the shell pattern question.

One of the things to be learned is to avoid the core box, excepting where it cannot be dispensed with.

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WHAT SHALL IT BE?

Election day has come and gone, and the Democratic party has the reins of government. This paper is not a political organ, and does not propose now to depart from its policy of not discussing political matters. There are, however, a few pertinent questions, important to every citizen, which the recent election has brought forward. Since the election of Lincoln the policy of one political party has been dominant. Though lacking a majority in the House of Representatives for some years, it held the Senate and the Presidency and had the balance of power. The one term of the opposing party in the presidential chair did not witness a change of policy for the reason that the Senate was still in control of the party that had run the government for a quarter of century, and no legislation subverting existing arrangements could be enacted without its consent.

For the first time since the late war another party is supreme in the executive and legistative branches of our government. Though the Senate is now Republican, it will be Democratic in a short time, without doubt. The question now arises, in the mind of every thinking person, what will be policy of the new and absolutely potent administration? What will be done with the tariff, with the currency, with our trade built upon reciprocity treaties, with the internal revenue tax, with our rivers and harbors, and in short, with the present plans of carrying on the business of the people, the power to do, which is delegated to the federal government?

It would be deviating from our custom to express any opinion whether there is need of changes in the conduct of the government, whether to uproot present methods and management would be wise or unwise. We hope that the conduct of affairs will be for the greatest good to the greatest number, that any new movements will be for the better, that conservatism will be in the ascendency.

CARE OF STEAM BOILERS.

BY ALBERT E. EDKINS.

We know from the experience that all boilers are gradually weakened by the work of destructive agents upon them from the time they are put into operation until they are discarded and carted away to the scrap heap in some rolling mill yard.

The rapidity with which this deterioration takes place depénds to a great extent on the following: 1st. The quality of material and workmanship; 2d. The location of boiler setting; 3rd. Last, but not least, the amount of care bestowed upon it by the man who is placed in charge.

One of the worst enemies of a steam boiler, with which we have to contend, is external corrosion, and it is to a great extent caused by negligence. This form of corrosion is often caused by the guage cocks, man holes, flange joints, tube ends, rivetted seams, &c., being allowed to leak and drip down the front and shell of boilers day after day where (oft times) "out of sight, out of mind," the plate is eaten away in a surpisingly short space of time to such an extend as to become dangerous. I notice that it is a very common thing to find the heads of boilers in the vicinity of the hand holes eaten away from the above cause. How often do we hear a hand make use of such an expression as this after making a hand hole joint and finding it leaks a little, "Oh, it's good enough!" Every engineer * * * will agree with me when I say that there is nothing good enough for a steam boiler in the way of care and attention, unless it be the very best which the engineer has in his power to give.

The old saying, "As a man sows so shall he reap," is never more applicable than to a boiler in regard to the result of good, bad or indifferent handling as the case may be. Just as soon as a leak is discovered around a boiler it should be attended to, as if not it only tends to make matters worse, as I have before stated by inducing corrosion, as hot water and coal soot combined are corrosive agents of great strength and it is surprising how soon they will eat away the sheet to one-half of its original thickness. As I stated above this is a very common occurance around hand hole doors and the plate is often found eaten away to such an extent as to need patching. I can attribute such cases as this to nothing but carelessness, as it can always be prevented by a little care and pains in making a joint. I have yet to find the hand hole that I can't make tight.

My way of making a hand hole joint is as follows: Clean the plate and sheet well, then wind about three turns of cotton wick tightly round the plate, cut a gasket of $\frac{1}{8}''$ rubber to fit plate snugly, then on top of it smear well with black lead or plumbago and oil. I never use red or white lead around a boiler except for pipe threads, and even for that I believe plumbago is the best. By using the black lead and oil on the rubber it can be removed at any time, and the gasket will adhere to the plate, having a smooth face, and can often be used three or four times. I have often packed so-called "hard ones" in this manner and made them quite tight when other means have failed.

For man hole plates I always use $\frac{1}{4}''$ asbestos board cut to fit the plate snugly, then soak it in water for an hour, put it on the plate smearing the side coming in contact with the boiler shell, well with black lead and oil. Then when breaking joint again it will only be necessary to pour some water over the asbestos to soften it and apply more black lead and oil, and it is ready for use again. I have made joint for a man-hole in this manner which has lasted four years and been broken every three months. I believe this to be the cheapest joint for a man-hole plate, taking everything into consideration. Asbestos is a good steam packing, but I would not advise its use on water joints, such as hand-holes, as the water will soak through it.

We now come to the internal corrosion, which is another form of wasting away, but it is not quite so rapid as external corrosion when left to take its own course. The action of internal corrosion may be classified under the following headings, viz: Chemical, Galvanic and Mechanical. It is chemical when seen in the form of the rusting away of plates in a uniform manner. When galvanic, its presence is made known by the rivet and stay heads being eaten away, also by pitting taking place in the tubes and sheets. We also find the ends of guage glasses eaten away thin in some boilers from the same cause. Galvanism is a species of electricity which is excited by establishing contact or communication between two metals through the medium of a liquid and it possesses energetic decomposing power. Mechanical action, such as grooving and buckling of plates, is caused principally by unequal expansion and contraction. If we look into this matter a little it will not be hard to understand the cause of buckling and grooving. Take for instance an internally fired boiler (one flue, or scotch-type) * * * and it is very evident that the difference of expansion between the furnace flue and the shell must be considerable, owing to the high temperature of the fire, and as the flue cannot expand very much endways on account of the rigidity of the heads, it has to adapt itself under these conditions somewhat to the shape of a bow, and it is from these actions that the grooving occurs in the roots of angle irons that secure the flue to the heads in this class of boiler. Mechanical action like the above frets and irritates the iron or steel until the skin is broken. The fracture is also acted upon by any acids which may be present in the water until the groove or fracture extends in many cases clear through the sheet. * * *

The practice of some engineers of opening the furnace doors of boilers to check the generation of steam instead of having and using dampers cannot be too severely condemed, as leaky seams, rivet cracks, and other evils must follow such a practice, to say nothing of boiler maker's repair bills, and yet it is daily persisted in by some men.

It should be the aim of every fireman and engineer to keep the temperature of the furnace as near one point as practicable, if they wish to have a boiler free from leaks and thus reduce the sudden expansion and contraction to a minimum. The man who throws on a heavy fire and lets it burn up and die down until there is barely enough incandescent fuel to ignite fresh coal, and charges up his furnace again with green coal is not doing his duty either to his boiler or his employer as such slovenly work cannot fail, in time, to produce bad results to the boiler, to say nothing of such a course being uneconomical in the generation of steam.

In regard to internal corrosion, where it is uniform and in the shape of rusting away of the plates, I believe the best thing is to get a sample of feed water analyzed and a compound prepared especially to counteract the action of the corrosive agent or agents in the water. For the second form of corrosion, which is galvanic, I know no remedy, except to watch boilers carefully and have them inspected regularly, so that all defects may be discovered and made good before they become actually dangerous. In the case of pitting, which occurs mostly in low pressure heating boilers where the condensation is returned continuously to the boiler, I would advise that a few pounds of sal-soda be put in the boiler during the winter, and when laying up the boiler for summer, after washing it out thoroughly with hose and making all joints good, put in 10 pounds of sal-soda and get up 3 or 4 pounds of steam on boiler alone, then let boiler cool off and when cool fill up with water to the stop valve on main steam pipe. The above treatment will arrest the action of pitting, and in a damp place where a boiler stands idle all summer, after smearing boiler all over with coarse oil fill up with water and put in ten pounds of sal-soda dissolved and let it remain until the fall or whenever it may be wanted. This treatment will keep the boiler free from external corrosion caused by a damp cellar.

To guard against grooving and buckling, I would say, have enough boilers to generate the necessary amount of steam without having to force your fires, the effect of which is to shorten the life of your boiler and this to at all the expense of economy in fuel. It is a mistake to put in two boilers of 100 h. p. rated capacity to do 250 h. p. actual work. It would pay well in the long run to put in four boilers of 100 h. p. rated capacity and run with slower fires and be in a position to shut one down at any time for cleaning. There is no advantage in forcing a steam boiler, look at it from any point we may, but I am well aware that it is a very hard matter to get some steam users to regard it in this light as it seems to them always a matter of dollars and cents in the first cost.

I came across a case not long ago where a man boasted to me with apparent pride that the man-hole plate of his boiler had not been removed since the boiler was put in, which is some nine or ten years ago, and that he only took out the hand-holes and washed out once a year. When such men as this are allowed to control steam boilers, is there any need to wonder that week after week we read in our daily papers of boiler explosions and loss of valuable lives and property? Many people think boiler explosions are purely accidental and can't be avoided; I maintain that this is a mistaken idea, and I feel sure that if all the details of these explosions were known the cause would in many cases be traced to ignorance and negligence of the common sense rules which should govern the operation of steam boilers.

From the reports of the different boiler inspection and insurance companies of this and other countries, also of districts where an Engineers License and Boiler Inspection Law are in force and faithfully carried out, it is fair to assume that these boilers which have exploded during the past year would not have done so had they been inspected.

No boiler of the horizontal tubular type should be allowed to run over a month, when generating steam for power, without washing out and the man-hole should be removed at least every three months and the fireman go inside with scraping tools and dislodge all the scale and deposit he can, afterwards taking in the hose with him and washing off tubes and shell thoroughly. It is a good thing two or three days before washing out to pump into the boiler 10 or 12 pounds of sal-soda, as this will soften the scale and make it much more easy to remove.

In case a boiler is badly scaled I have the following a good course to pursue: when a boiler can be laid off for a few days, put in from 20 to 50 pounds (according to state of boiler) of caustic soda and get up 60 pounds pressure of steam, and keep it up for a day, then let steam down but keep enough fire going to keep boiler hot and water at 212° F. for a few days. Then let boiler cool down, let off water and wash with hose under good pressure, and repeat the dose if necessary. This treatment has been found to clean a boiler when everything else has failed. Some engineers are in the habit of blowing off a boiler under steam pressure and turning on the cold water to wash out while hot, as they claim by so doing it takes off the scale. That it does so is no doubt a fact, as the sudden contraction of the plates is so rapid that the scale is cracked and falls off. In following such a course a man may get off some of the scale, but the damage done to the boiler from such sudden contraction is such that it soon means a bill from the boiler shop for repairs.

The proper way to wash out a boiler is to let both boiler and brickwork cool down, if possible, then run off the water, and open up hand-holes, when the mud and sediment will be found in the bottom of shell and can be easily removed. After filling up the boiler with cold water put a slow fire under it and gradually warm it up. Forcing a heavy fire under a boiler full of cold water is as bad or worse than blowing off under pressure and washing out hot, and the engineer who boasts of having got up 20 pounds of steam from water at 45° F. in 20 minutes, only shows his own ignorance.

Every man having charge of steam boilers should take pride in keeping them, and everything in connection with them, clean and in good order. He should be cool and collected in case of an accident and not, like a man I knew of a short time ago who took a situation to run a small engine and boiler and when the second day, the guage glass broke, put for the street and could not be induced to go back until the engineer from the next door had been in and shut off the valves communicating with the boiler. Never allow any oil to enter your boiler. I am aware that many engineers believe that a little cylinder oil in a boiler is a preventative against scale; but be this as it may (and I am not prepared to contradict it), it is a well known fact to many engineers that very serious damage has been done to boilers by reason of oil mixing with the impurities held in the water and forming a kind of paste which in some cases has fallen to the bottom of boiler and remained there, and owing to the fact that this oily paste has kept the water from taking the heat from the plate, the result has been that the plate has been heated to such a temperature that the pressure has bulged the plate down, and in some cases a fracture has taken place. Some engineers will tell you they have allowed the oil from the condensation of exhaust steam to be returned to the boiler for years without any harm to the boiler, but I could tell you of places where it was only allowed to go in three months or so and the result was overheating of sheets, and when the sheets were cut out the oil and mud were found thick on the water side of sheet. The best cure for anything is prevention, and if the oil is being returned in condensation from your exhaust heating system to your boiler, my advice is to take means to prevent it at once, or if you neglect to do so you may have trouble. It is a pleasure to go into boiler rooms where cleanliness is observed, not only on the brass mountings and fronts, but up over the tops of boilers, which in too many places serve as a lumber room for pipes, bricks, old bags and a large quantity of dust. A boiler should be kept as clean on top as in front, and it is a very small matter to keep it so when once it has been put in that condition. The plea which is so often put forth by engineers as an excuse for a dirty, slovenly engine and boiler room, "Oh if it suit the boss it will suit me," is about played out. The men who get on well are those who take an interest in all they do, are clean and tidy about their engine rooms, and put in their spare time reading and studying, in order that they may keep up to the times and be in a position to take advantage of a better situation when it is offered. It is this style of men who get there every time.—[Extracts from a paper read before the C. A. S. E. at Hamilton, Ont.

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To know how to pick out a good grindstone for tools—an important matter to every one using tools—send for a copy of the Cleveland Stone Company's elegant catalogue G., on this subject, illustrated with very artistic photogravures. Their address is 36 Wilshire Bldg., Cleveland, Ohio.

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Prof. Carpenter, gives the rate at which a jet of steam flows through the nozzle of an injector as 1,400 feet per second for all pressure.

QUESTIONS AND ANSWERS

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(458.) Louis Adamson, Brookings, S. D., writes: 1. "Is it more economy to cushion with exhaust steam than with live steam in a non-condensing engine, running 85 revolutions per minute, steam pressure 85 pounds?, 2. Is it more economy to use two boilers than one? 3. How much lead should the steam-valve have on a Corliss engine, running 85 revolutions per minute? 4. What is the H. P. of an engine running 85 revolutions per minute, steam cut off at one-fifth of the stroke and gauge pressure 85 pounds, size of cylinder 14"x42", ½" clearance, thickness of piston-head 8", size of piston rod 2¼"? How much coal should this take a day of 11 hours? A.—1. Exhaust steam. 2. If you mean whether it is better to have the same heating surface in two boilers than one boiler, as in the case of one 100 H. P. or two 50 H. P., we do dot see any advantage in it, unless the capacity required is large. Where a boiler has to be crowded to get the evaporation required, it is wise to put in another. 3. Generally about 1-16", but no rule can be given. It depends on the load, the peculiarities of the engine, etc. The only accurate method is to put on an indicator. 4. The water consumption will be about 24 pounds per H. P. per hour. Theoretically, it is about nineteen, but the actual is about 25 per cent. more than the indicated. The amount of fuel necessary to evaporate this quantity of water, depends so much on the furnace and boiler, that we can not give you any figures.

(459.) "Mechanic," Philadelphia, Pa., asks: "I wish to inquire what questions are most likely to be asked an applicant for a stationary engineer's license. A.—No two examiners of engineers conduct an examination in the same way. While the questions elicit about the same facts, they vary in form considerably. If an examiner is himself a practical engineer and a proper man for the place, he asks the applicant questions on the philosophy of heat and steam, boiler construction, design, material for boilers, strength of same, figuring pressure, care and management of boilers, figuring safety valve, construction of engines, their care and management, indicator practice, etc. It is well to be posted on these points, and to know how to take care of a steam plant before presenting one's self for examination.

(460.) Victor Ferriot, Akron, O.; writes: "Please let me know through 'questions and answers', how to cool off a hot box without using water or patent oils or without stopping the machine." A.—That is a hard one to answer. Take off the caps of bearings and if there is any gum or other substance in them that should not be there, clean out the best you can. See that the lubricators feed properly, and run slow for a time if possible. We do not know of any way to cool off a hot box satisfactorily without shutting down. As for oils, they are all right, patent or not, if they contain no ingredients that injure them as lubricants. Lubricating oil should be of good quality.

(461.) Samuel E. Kay, Chester, Pa., writes: "I have a question I would like you to answer in your paper—how to run a 16 candle power lamp, with a battery. I have a battery made of 6 jelly tumblers, carbon zinc and salammoniac. I also have an induction coil of 1000 feet made of 28 magnet cotton covered copper wire. The lamp I meant is a 16 candle power incandescent." A.—It would not be practical to run a 16 C. P. lamp from the battery you speak of. For instance, a 16 C. P. lamp of whatever voltage, needs about 55 watts and in your case the voltage would be about 6, thus a single lamp consuming 55 watts would require 55 ÷ 6 = 9.16 amperes, the resistance of the lamp being 6 ÷ 9.16 = .065 ohms, and to carry this current of 9.16 amperes without too great a loss, quite a heavy wire would have to be used. On the other hand the size of cells would not make possible the taking of 9 amperes from them for but a short time if at all. Should they be made larger then they would become polarized when in continuous use, thus destroying their efficiency. However, a small 1 or 2 candle lamp could be used from about 6 Leclanche cells, for use in a small room, and a push-button in circuit, to allow of the telling of the time of clock, etc.

(462.) M. Beck, Brookings, S.D., writes: "I have a small dynamo in which the south pole is built up of a number of small electro-magnets. It is in the form of a circle with the poles all out, and is keyed fast to the main shaft. They are to be excited by a wire running through the shaft to them. The north pole is a pair of poles similar to the ordinary poles of a common machine, but both north. The armature is built of wire wound so as to be in the form of a hollow cylinder, to fit over the south or center magnet. It has appropriate ends bolted on with a commutator attached, and is to run loose on the shaft. All the little troubles like the oil running into the armature, etc. have been overcome. Please give me your honest opinion as to whether you think there is anything in it or not. Would it be better if the inside magnet was divided into two, one south and the other north, with opposing poles opposite?" A.—If constructing a slow speed dynamo, it would be advantageous to use a large number of radial magnets both inside and outside of the armature. The armature could be from four to six feet in diameter. On the other hand, if a high speed machine is wanted it is thought that four stationary magnets would serve better, two inside and two outside of the armature. It would seem as though the only special advantage accruing from this construction would be an increased magnetic field of even intensity. As to the efficiency, this could alone be ascertained by a prolonged actual test.

☞ A number of questions stand over for answer in futnre issues. All are answered in order of priority.

STRUCTURE OF THE STEAM-ENGINE.—IV.

BY PROF. R. H. THURSTON.

The general arrangement and disposition of the parts of a triple-expansion engine, as built by the Corliss Co., is seen in Fig. 43. Here the low-pressure cylinder is divided, one of its two elements being coupled with the high-pressure cylinder on the right, and the twin with the intermediate cylinder on the left. The cranks are set at 90 degrees. These engines have cylinders 20, 34, 36, and 36 inches diameter and 5 feet stroke of piston. All cylinders are completely steam-jacketed, heads included, and the steam is somewhat superheated. Jet-condensers are used. Tte capacity of the engine is 1000 I. H. P. or more, and its "duty" is about 135,000,000 pounds; the fuel used, when of good quality, amounting, on test, to 1.44 pounds per horse-power per hour.

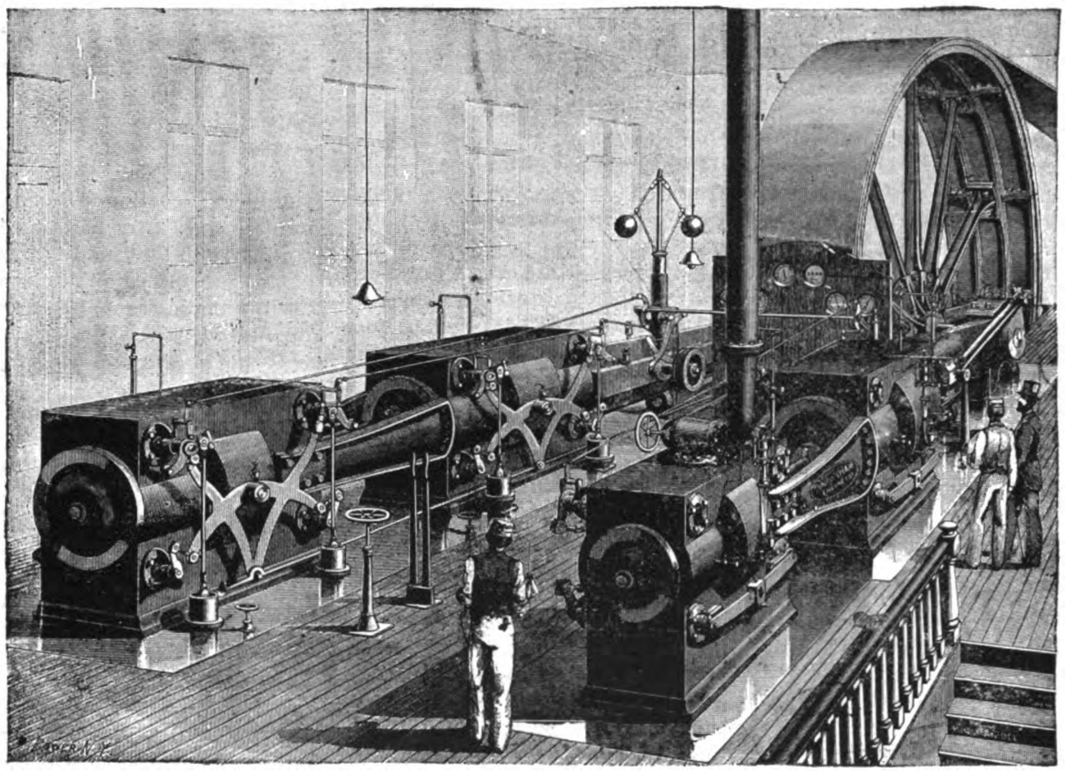


FIG. 43—TRIPLE-EXPANSION CORLISS ENGINE.

"Compounding" simple engines is often a very economical and profitable plan. The method depends mainly upon the design of the engine to be so altered. The common forms of stationary beam-engine are commonly improved by what is called "McNaughting," placing a new high-pressure cylinder beside the old cylinder and connecting it to the beam either at the old air-pump centre, if condensing, or to the point at which the air-pump would have been attached, if the engine be non-condensing. The vertical marine engine may sometimes be altered into the compound form by placing the new cylinder above the old and the two pistons on a common rod. Many engines cannot be satisfactorily compounded, and others only by the establishment of a separate complete high-pressure engine in close proximity to the old and arranging the latter to take its steam from the former.

The gain to be anticipated by such improvement and alteration of type will depend upon the character of the altered machine. Should it be a very wasteful engine, enormous gains may be anticipated if, while adding the new construction, the old is put in good order. For cases in which the old engine is reasonably economical, the gain is simply that due to reduction of cylinder-condensation, and this is at least partly compensated by the friction of the added parts. Savings as great as one half are not unusual in such cases as the first, and as little as ten per cent, in cases like the second, are common. Whether such a gain is, on the whole, financially advantageous is still another question to be settled for each case.

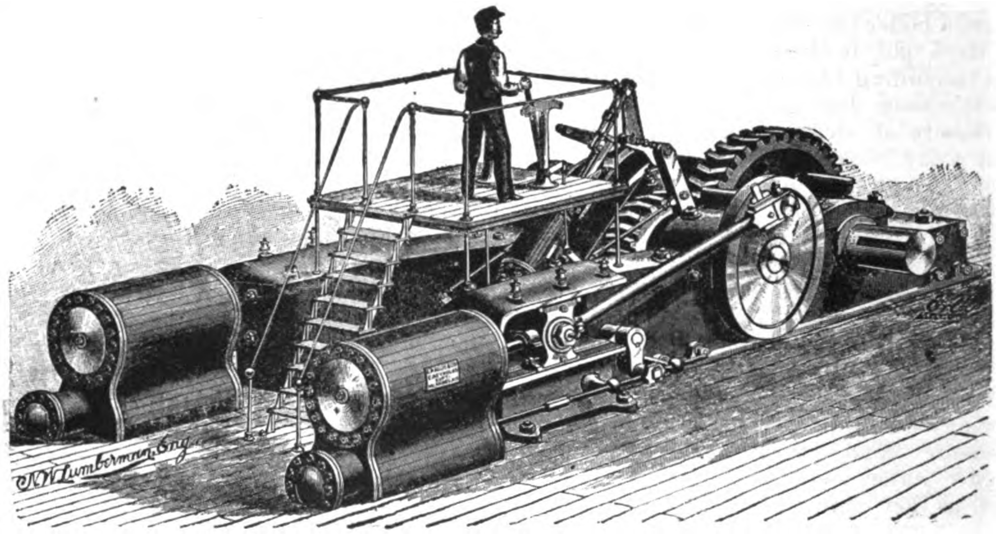

N.Y. Lumberman Eng.

FIG. 44.—REVERSING ENGINE.

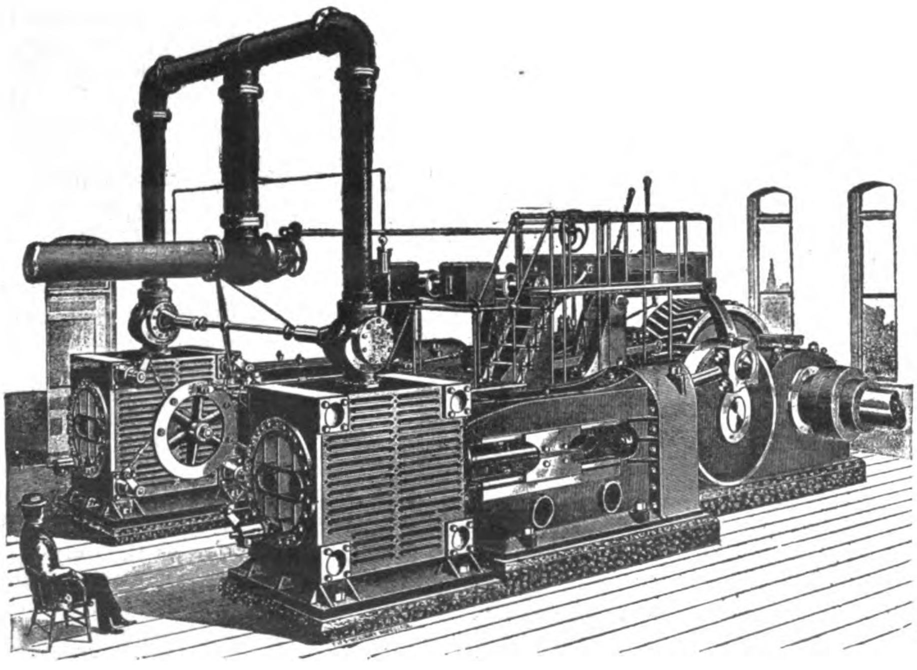


FIG. 45—REVERSING ROLLING-MILL ENGINE.

Rolling-mill Engines are often constructed especially for their work. For heavy mills they are often made to reverse.

The last figure illustrates a common form of reversing-engine. The engine frames are heavy cast-iron girders having a bearing the entire length on the foundation. On the top side of the frames are the main journals. These journals are provided with means for taking up wear and adjusting the helical gears which transmit motion from one shaft to the other.

The main valves are placed under the cylinders, the valve-chambers forming a part of the cylinder casting, thus bringing the steam-ports on the lower side of the cylinder, to allow water of condensation to pass out through the exhaust-ports without danger to either cylinder or head. As an additional means of safety the builders often use "snifting-valves" on each end of the cylinder.

Where very heavy rolls are employed, as in making armor-plate, for example, an engine is often demanded which map be instantly reversed, driving with equal facility in either direction. Fig. 45 exhibits such an engine as built by Allis Co., from Mr. Reynold's plans, for Messrs. Carnegie, Phipps & Co. of Pittsburgh. The fly-wheel is here, also, dispensed with, and the engine are designed for high speeds of rotation and very heavy work.

The steam-cylinders are forty inches diameter by fifty-four inches stroke, with Reynolds' Corliss valve-gear without the drop cut-off mechanism; the speed of the engines is controlled by the operator, and is varied in every-day practice from 5 revolutions to 120 revolutions per minute. Tower from the crank-shaft is transmitted to the roll-shaft by means of a pair of shrouded helical-tooth steel gears.

The reversing mechanism, operated by steam, is controlled by a lever on the engineer's platform from this position he has unob tructed view of all parts of the ngine and roll-train.—[From "A Ianual of the Steam-Engine," by Thurston, published by John Wiley t Sons, 53 E 10th St. N. Y.

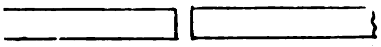
BLACKSMITHING FOR ALL MECHANICS.

BY JOSEPH HILL.

One of the first principles needed, s to become acquainted with the grain of iron. Some beginners lose ight of the fact, that iron has a grain like wood, and it is a delusion mong a great number of experienced smiths, that if a piece of forging s made from a solid piece of iron, it s far the best job, when such is ot the case, for they do not take nto consideration, the running of he grain. For example, I wish to nake a ring or collar, say 3″ Dia. of hole and about 1″ thick. To make t from a solid piece take a flat piece of iron, punch a hole and work it out to the desired size.

That way, you plainly see, we have the end or cross grain. The other and right way is to take a piece of 1″ square iron, the needed length, bend it to a circle and weld it; there you find the grain all the same way, thereby making it 50 to 75 per cent stronger.

The above is a very simple illustration, but that principle must be carried out in all general blacksmithing, if you want strength and lightness combined. I have seen very large and costly forgings broken such as crank shaft, etc., some two tons in weight, simply because the above principle had not been adhered to.



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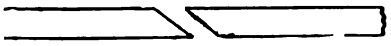

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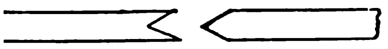

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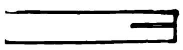

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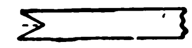


5

The art of heating metals will come more by experience than theory can teach, although it is well to caution beginners to beware of the prevailing idea among most smiths, that the iron you are about to weld should be very soft to ensure good welding. True it is, it will retain the heat a little longer to enable you to work it, but in so doing the toughness or fiber of the iron is destroyed, leaving the welding brittle and of little strength, instead of being as strong or, as it should be, stronger than the other part of the bar. I could give the temperature to weld, but that is not practical. My experience has been to heat iron for welding purposes so that it will bear a blow from tne hammer directly it leaves the forge or furnace, then you are sure of retaining the strength.

Iron welding being much easier than steel, we are apt to become careless in the working it as it seemingly retains its compactness, but when a little strain takes place it is easily parted.

Welding steel is quite different. That metal is such, that when overheated, it will soon make you aware of the fact, by crumbling to pieces. A smith has to acquire this knowledge of heating steel for welding by practical experiments and retaining the same in the vision. The reason some men are not good welders or heaters is no fault of their own, but because of imperfect vision.

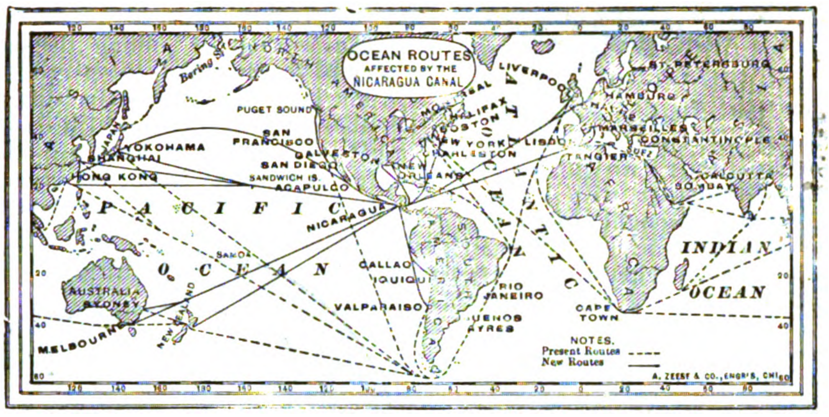
The methods of welding iron, are, butt weld, Fig. 1; common scarf, Fig. 2, and the V-scarf or weld, Fig. 3. The butt weld for most work is more rapid than the other methods, but not so reliable, for the grain of the iron is not so thoroughly united. Common scarf is the most popular among the majority of smiths—and rightly so—up to sizes of iron about 1¾″ diameter. The reason it is better than the butt weld is because you have a considerable lap running with the grain of the rod you are welding and the working of it improves it by closing the grain, but in a butt weld you so often draw the iron when in a state of flux, thereby parting or severing the grain, and another reason is you have more welding surface by the common scarf than by the butt.

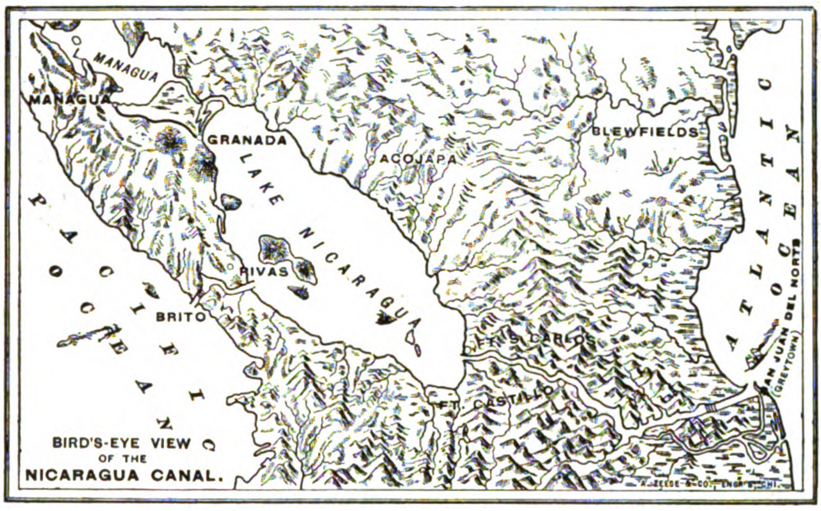
V-welding I consider the strongest and easiest method of welding for sizes of iron above 2″ diameter or square, bars, etc. In the first place you have much more welding surface than by the other methods and can well afford a little spot not welded and then be as strong as the other. Another reason is you are prepared by this weld for any way the strain may come, for in this method you have the combinations of the others, as you readily can see by looking at the cuts. Again, most of this kind of welding is done or should be done in fire, and can so readily be taken from the fire to the steam hammer or anvil, as the case may be, thereby insuring safety of position, for it should be adjusted in the fire when you are preparing to weld it.

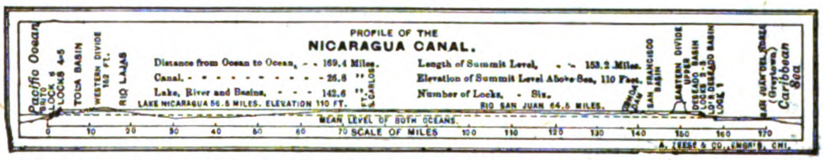
This method of making a V-scarf (shown in Fig, 4) may be a help to many smiths. At the present it causes hard work and extra time. The general way of making the scarf is to take your bar of iron, say 4″ or 5″ diameter, split it at the hammer in a bottom swedge, as in Fig. 4. In so doing you reduce the size a very little and have taken away the resistance from the chisel when you cut the V, as in Fig. 5.

THE PROPOSED NICARAGUA CANAL.

The illustrations show the route of the proposed Nicaragua canal.






PROFILE OF THE
NICARAGUA CANAL.
Distance from Ocean to Ocean, - - 169.4 Miles.
Canal. - - - - - - - - - - - 26.8 "
Lake, River and Basins, - - - 142.6 "
Length of Summit Level, - - 153.2 Miles.
Elevation of Summit Level Above Sea, 110 Feet.
Number of Locks, - Six.
Pacific Ocean
BRITO
LOCK 6
LOCKS 4-5
TOLA BASIN
WESTERN DIVIDE 162 FT.
RIO LAJAS
LAKE NICARAGUA 56.5 MILES. ELEVATION 110 FT.
FT. S. CARLOS
RIO SAN JUAN 64.5 MILES.
OCHOA DAM
SAN FRANCISCO BASIN
EASTERN DIVIDE
UPPER DESEADO BASIN
DESEADO LOCKS 2-3
LO'R DESEADO BASIN
LOCK 1
SAN JUAN DEL NORTE (Greytown)
Caribbean Sea
MEAN LEVEL OF BOTH OCEANS.
0 10 20 30 40 50 60 70 SCALE OF MILES 100 110 120 130 140 150 160 170
A. ZEESE & CO., ENGR'S, CHI.

Since 1849 the need of a water route joining the Atlantic and Pacific Oceans has been one of direct importance to the American people, and the thorough work of exploration and investigation pursued almost uninterruptedly since that date has been mainly accomplished by or under the auspices of our army and navy engineers, acting in obedience to orders of the Government and at the Government's expense. Every locality from Tehauntepec to Darien which might afford claims for consideration has been thoroughly examined in these explorations. It is a significant fact that the engineers of our government from first to last have expressed a decided preference for the Nicaragua route, and that none of them have ever expressed any doubt regarding its feasibility. The solution of the problem of inter-oceanic communication by this route has moved more rapidly and more surely on its way as a full and intimate knowledge of its characteristics has been obtained, and it now commands public attention as never before, with absolute assurance of ultimate success.

A meeting of delegates, appointed by the governors of the various states, to consider questions respecting this great engineering work and to devise means for its early completion, met in St. Louis on June 2 last and issued an address to the people. The two great political parties indorsed the project in their conventions, and the matter is now fully before the country and is attracting general attention.

The three cuts give a vast amount of information as to the location and plan of the proposed work and the advantages it will be to commerce.

The Flow of Water in Pipes.

Many formulæ have been devised by various engineers for expressing the relation between the velocity of flow in a pipe and the head required to produce it. Unfortunately all of them are complicated, and cannot be used for mental calculation or in making rapid approximations. It may be noted, however, that in a vast majority of cases arising in practice, the velocity of flow lies between 2 feet and 4 feet per second, and on an average is 3 feet per second. The head required to maintain this latter velocity through a length of clean cast-iron pipe is then

$$\text{Head in feet} = \frac{\text{Length of pipe in feet}}{25 \times \text{diameter of pipe in inches}}$$

and the discharge in cubic feet per minute is very nearly equal to the square of the diameter of the pipe in inches, the error being under 2 per cent. in excess. Both these calculations are easily performed mentally. For a velocity of 1 foot per second less than 3 feet per second the head must be reduced one-half and by a proportianate amount for intermediate cases. For a velocity of 1 foot per second more than 3 feet per second, the head must be increased by .7 times that required for a 3 foot velocity, and that required for intermediate cases can again be determined by adding a proportionate amount for that required for the 1 foot increase. In this way the head required to maintain through a clean cast-iron pipe a velocity of not less than 2 feet a second, nor more than 4 feet a second, which are the limits usually adopted in practice, can be determined mentally with an accuracy sufficient for 99 per cent. of the cases that arise in an engineer's practice. Having the discharge at a velocity of 3 feet a second it is of course easy to obtain the discharge at any other velocy.—[London Engineering.

◆

The waters of the Avre and Bigue are to be carried above the Seine into Paris, by a bridge over an inclined floor. The work is well under way at the present time, above this floor is to be a foot bridge.

◆

THE space occupied by the other countries than the United States, at the coming World's fair, will exceed the total space occupied by any previous World's fair.

◆

IN 1890 the national debt of Great Britain and Ireland was $87.79 per capita. $20.46 represented the rate in the United States at the same period.

FLUES IN BOILERS.

A boiler shell, with the pressure acting on it from within, is in a state of stable equilibrium; for if any small deformation is produced in it, from any cause, the pressure tends to remove the deformation and restore the boiler to the form of a true cylinder. A flue, however, with the pressure on the outside, is in a state of unstable equilibrium, for the pressure tends to magnify all deformations and to cause the flue to depart more widely from the cylindrical form. In other words, pressure tends to keep the shell of a boiler in its strongest shape, and tends to force a flue into its weakest shape. Flues, therefore, are elements of weakness in a boiler, and it is particularly important that proper attention be paid to them.

The U. S. Treasury rules for finding the strength of lap-welded flues are as follows (see Amended Steamboat Rules and Regulations for 1891): If the diameter of the flue is not less than 7 inches, and not more than 16 inches, and the length not over 18 feet, multiply the thickness of the flue, in inches, by the constant number 4,400, and divide the product by the radius of the flue in inches. The quotient will be the pressure allowable. "For every foot or fraction thereof over 18 feet, deduct 3 pounds per square inch from the pressure allowable on an 18-foot flue; or, add .01 of an inch to the thickness of material required for a flue 18 feet in length of every three feet or fraction thereof over 18 feet." The thickness of such a flue as is described above is to be determined by the following rule: Mutiply the radius of the flue in inches by the pressure per square inch that it is desired to carry, and divide the product by the constant number 4,400. The quotient is the required thickness, in inches. "The thickness of lap-welded flues, however, shall in no case be less than the diameter of the flue multiplied by .022."

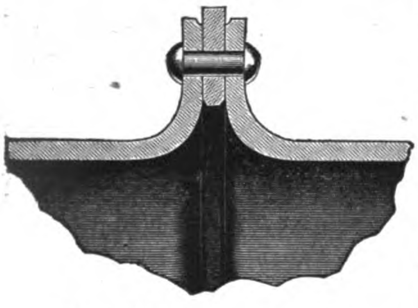


FIG. 1—THE ADAMSON RING.

It is further provided by the Treasury department that "Lap-welded flues 7 inches and not over 16 inches in diameter, shall be made in lenghts of not over three (3) feet, and fitted one into the other and substantially riveted; or in lieu thereof shall be corrugated to a depth of not less than three-fourths of an inch outwardly and at a distance of not over three feet between such corrugations: Provided, such corrugations are made without in any manner reducing the thickness of the material in the flue at the points of corrugation to less than the least thickness of the material in the body of the flue, or that such flues are made in sections of not over three (3) feet in length, and flanged to a width of not less than two (2) inches, and riveted substantially together with a wrought iron ring [see the cut of the Adamson ring], having a thickness of material of not less than the thickness of material in the flues, and a width of not less than two (2) inches riveted between such flanges."

Flues whose diameter is more than 16 inches and less than 40 inches are separately considered. Of such flues it is required that they "shall be made im lengths of not over three (3) feet, fitted one into the other and substantially riveted; or flanged to a depth of not less than two (2) inches and riveted together with a good and substantial wrought iron ring between each joint; and no such ring shall have a thickness of less than half an inch nor a width of less than two (2) inches." The steam pressure allowable on such flues is to be determined by the same rule as that given above for the smaller flues, except that in the place of the constant number 4,400 that is given above, we must use the constant number 2,840.

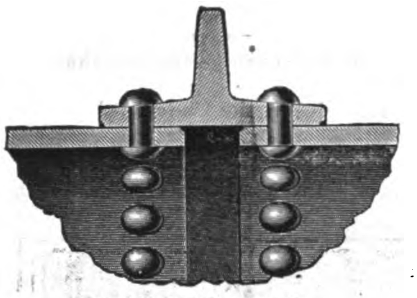


FIG. 2—T-IRON RING.

In the Amended Steamboat Rules and Regulations for 1892 there appears the following modification of the rule given above as applying to lap-riveted flues not over 16 inches in diameter: "But when such flues are used under a pressure of over 60 pounds and less than 120 pounds to the square inch, they may be made in sections of not over 5 feet in length and connected in the manner prescribed for sections 3 feet in length; and all lap-welded flues and tubes using 120 pounds of steam, and under, shall have a thickness of material of not less than the standard thickness. The following shall be the standard thickness of lap-welded flues and tubes from 1 to 16 inches in diameter using steam under 120 pounds to the square inch:

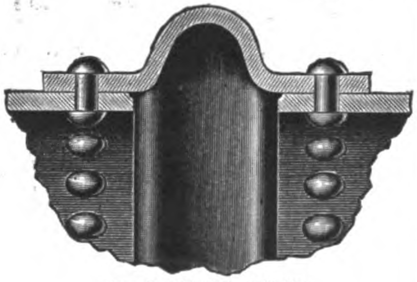
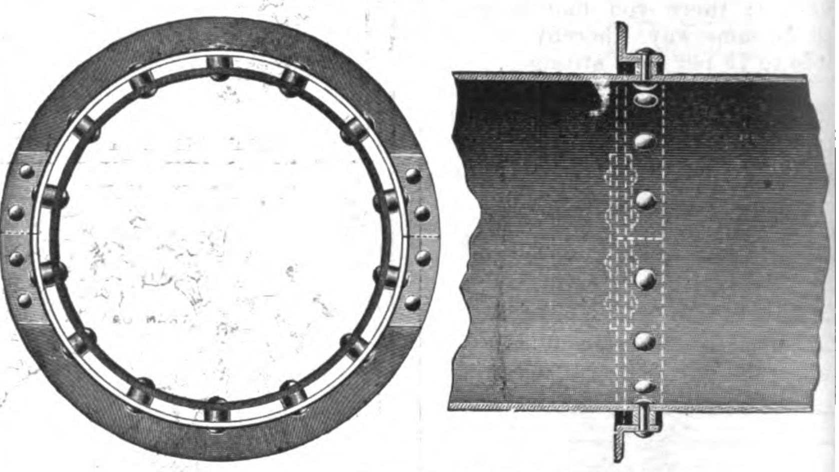


FIG. 3—STEEL HOOP.

Outside Diameter.	Thickness.	Outside Diameter.	Thickness.
1 in.	.072 in.	4½ in.	.134 in.
1¼	.072	5	.148
1½	.083	6	.165
1¾	.095	7	.165
2	.095	8	.165
2¼	.095	9	.180
2½	.109	10	.203
2¾	.109	11	.220
3	.109	12	.229
3¼	.120	13	.238
3½	.120	14	.248
3¾	.120	15	.259
4	.134	16	.270

Although the foregoing regulations of the Treasury department relate to lap-welded flues, they would doubtless be also applied to rolled flues when used in the marine service, notwithstanding the fact that the rolled flue is somewhat stronger, on account of its more perfectly cylindrical shape. Rolled flues are used in land boilers to some extent in this country, and very generally in England and other parts of Europe. Until recent years it was not found practicable to roll them in lengths of more than three feet or so, and where they were fitted together at the ends, and riveted, the double thickness of metal at the joint served as a sort of stiffening ring, and unless the pressure to be carried was high, engineers did not consider it necessary to provide additional rings for securing the necessary stiffness and resistance to collapse.

The method of joining the sections of the flues that is referred to in the Treasury rules above given is illustrated in Fig. 1, which shows what is technically known as the "Adamson ring," from its having been first introduced by Mr. Adamson, in 1851. The ends of the sections are flanged outward, as shown, and are securely riveted together with a ring of wrought iron or steel between. This ring, which should be not less than half an inch thick and not less than two inches wide, is calked on the outerside of the joint, and, if the flue is large enough to admit of it, it is also calked on the inside, as indicated in the cut. One of the important features of this joint is that both the flanges and the rivets are entirely protected by water. There is also no thickening of the flue by over-lapping pieces, so that the joint is not likely to burn out. Mr. Adamson has submitted these flanged joints to severe experimental tests, which they withstood remarkably well. The only serious objection that has been urged against them is, that in case one of the segments of the flue should burn out, either on account of scale or for any other reason, it could not be replaced without removing the head of the boiler. This objection does not seem to us to have any great weight, because in many cases the flue comes so close to the shell that it is almost impossible to do a satisfactory job of riveting on any kind of a joint, without removing the flue from the boiler; and if there are projections of any sort upon it, it will be necessary, in removing the flue, to take out one of the heads.



FIGS. 4 AND 5—RING OF ANGLE-IRON, WITH THIMBLES.

Fig. 2 shows a method of uniting the parts of a built-up flue, which may be used with advantage in some cases, though we should prefer the Adamson joint shown in Fig. 1. Fig. 2 shows a ring of T-shaped wrought iron, which is preferably made in one piece and shrunk on the ends of the segments to be united; though it may be made in halves, if necessary, the two parts being riveted firmly together when in position, by running straps along the web of the flange on both sides near the joint and riveting through both straps and the web. When the flue is large enough to admit of it, the joint should be calked both inside and out, as indicated in the cut. If the flue is too small for this, there is no necessity of having the abutting ends of the flue as far apart as they are shown in the cut. T-shaped wrought iron rings, similar to that shown in the figure, and made in halves, are sometimes riveted directly to the flue, midway between the joints, when the flue either through age, through increase of pressure, or through fault design, requires more stiffening than the builder has given it. Rings of angle-iron are also used for this purpose.

Fig. 3 shows a ring of steel, hoop-shaped in section, which is sometimes used in building up flues in the place of the T-iron ring illustrated in Fig. 2. The advantage claimed for this form of joint is, that it has a certain amount of elasticity, and that it yields sufficiently to prevent any very severe strain from unequal expansion and contraction in the flue and boiler. This form of ring should be made in one piece and be shrunk on, and then riveted. It should be calked on the outside, and on the inside also if the flue is large enough to admit of it.

At the present time, flues are rolled of all lengths up to 18 feet. If a longer boiler is required, 21 feet long for example, it is customary to use a rolled flue 18 feet long, pieced out with an additional section three feet in length. The joint where the flue sections come together gives stiffness enough, ordinarily, to prevent the collapse of the shorter segment; but the long section should be supported by some additional means. Rings of angle-iron, or of T-iron like that shown in Fig. 2, may be riveted around the flue at intervals of from 3 to 5 feet, to give the necessary stiffness, or the device shown in Figs. 4 and 5 may be adopted. There is some liability to overheating when the angle-iron is riveted directly to the flue, yet this is often done without giving rise to any such trouble.

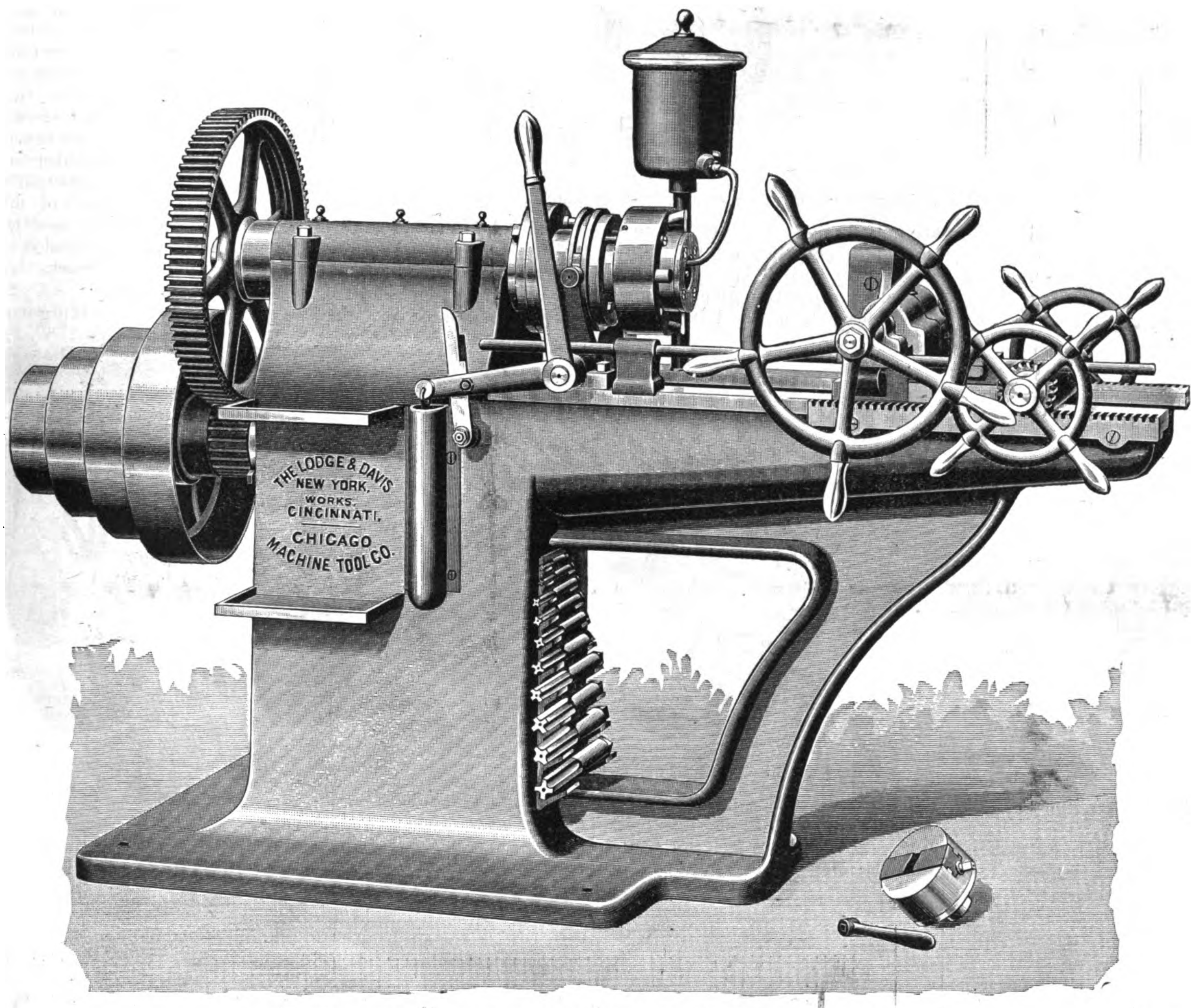
The ring shown in Figs. 4 and 5 seems superior to the plain ring, however, because water can circulate freely between the rivets, cooling both the rivets and the flue, and greatly lessening the likelihood of overheating. It consists of a ring of angle-iron or U-iron, made in halves, with the ends riveted together by a double strap, as indicated in the cuts. There is a free space of about one inch between the ring and the flue, all around, and the two are kept apart by thimbles that are spaced 5 or 6 inches apart. The ring and the flue are secured to one another by rivets which pass through the thimbles, as shown, and are headed over inside of the flue and outside of the angle-iron or U-iron. These rings are used in England much more than in this country, because flue boilers are much more common there than here. It will be interesting, therefore, to quote the opinion of Mr. Henry Hiller, Chief Engineer of the National Boiler Insurance Company, with regard to them, as he is thoroughly familiar with the best English practice. "The angle-iron," he says, "should not be less than 3"x3"x9-16". The ferrules between the hoop and the plate should be about one inch thick [i. e. one inch long], and the rivets should be spaced about six inches apart. With the exception of the part that requires riveting over, the rivet should be as cool as possible when it is inserted, as otherwise the excessive contraction in so long a rivet will be likely to induce such a strain as to fracture the head. The ferrules should fit tightly between the hoop and the flue, and the rivets should fill the ferrules." These rings are made in halves, as explained above, and the ends of the halves are made to butt together, and are secured by securely riveting a double strap to the web of the ring where the joint comes, in the manner indicated in the cuts.

Mr. Hiller does not recommend this form of ring for new boilers, nor do we, unless there is some special reason for it. It is often serviceable, however, when the flues of a boiler were originally made too weak for the pressure it is desired to carry. For new work we strongly recommend Mr. Adamson's joint, shown in Fig. 1, or the steel hoop shown in Fig. 3. A few years ago a ferry-boat plying about New York city was built with rings of this sort around her flues, except that in place of the angle-iron shown in Figs. 4 and 5 half-round iron 2¾ inches wide and 1½ inches high was used. The rings were placed along the flues at intervals of about 20 inches, and the rivets were spaced 8 inches apart. This stiffening proved insufficient, and a vast amount of trouble resulted. In our opinion the rings used in this case were much too small, and were weak in shape. The flue was 36 inches in diameter, and if this form of strengthening ring was to be used at all, a heavy ring of angle-iron should have been employed in the place of the weak, half-round strips. If we remember rightly the trouble was removed by the substitution of corrugated flues for the plain ones.

It may be well to say in this place that we do not approve of flue boilers, as a general rule. There seems to be no special advantage in them, and they are inherently weaker than the tubular form. We believe that greater safety and economy, and more general satisfaction, can be had from tubular boilers than from any other form. Flue boilers are used in some parts of the country in saw-mills, where refuse is burned for fuel; and we have known the owners of these mills to object to tubular boilers because they were economical. It was necessary, they said, to burn all their refuse, and if the boiler wouldn't do it, it was necessary to have separate furnaces constructed for the purpose. Nowadays, when all things are put to use and the word "waste" is nearly obsolete, we seldom hear this objection urged.

There are other points that should be mentioned in connection with flues, and we shall return to the subject in a later issue.—[The Locomotive.

IMPROVED STANDARD FULL AUTOMATIC BOLT CUTTER AND NUT TAPPER.



IMPROVED STANDARD FULL AUTOMATIC BOLT CUTTER AND NUT TAPPER.

The annexed cut represents an improved 4-die automatic bolt cutter, newly designed by The Lodge & Davis Machine Tool Company, of Cincinnati, Ohio.

The machine is designed to cut bolts, and tap nuts or same, from ⅜" to 1½".

It is extra heavy, the entire frame being cast in one piece. The front of the machine on which the carriage slides is supported by a heavy brace, thus giving the greatest amount of stiffness.

The driving cone is of extra large diameter, and is provided with wide steps for belt.

The gearing is proportioned 5 to 1, and has an extra wide face.

The carriage has a feed of 17 inches and a bearing of 13 inches gibbed to the shears. The jaws of vise are arranged to take the full capacity of the machine without being changed. The jaws are also arranged to take several nuts at once, being a great saving in tapping.

The head is positive in motion, and an automatic stop is provided for opening the dies in any position of the carriage.

The dies have a large bearing in the barrel and ring, also having a fine adjustment. Every part is accessible from the outside, and the dies can be changed in less than a minute.

The machine is provided with a force pump, throwing a steady stream of oil into the tank over the head.

The frame of the machine is used as a reservoir into which the strained oil flows after being used by the machine.

For further information, address the builders.

BARNES FRICTION CLUTCH PULLEYS.

The accompanying cuts represent the principles of one of the latest improvements in the line of friction clutch pulleys and cut-off couplings manufactured by the J. H. & D. Lake Company, of Hornellsville, N. Y.

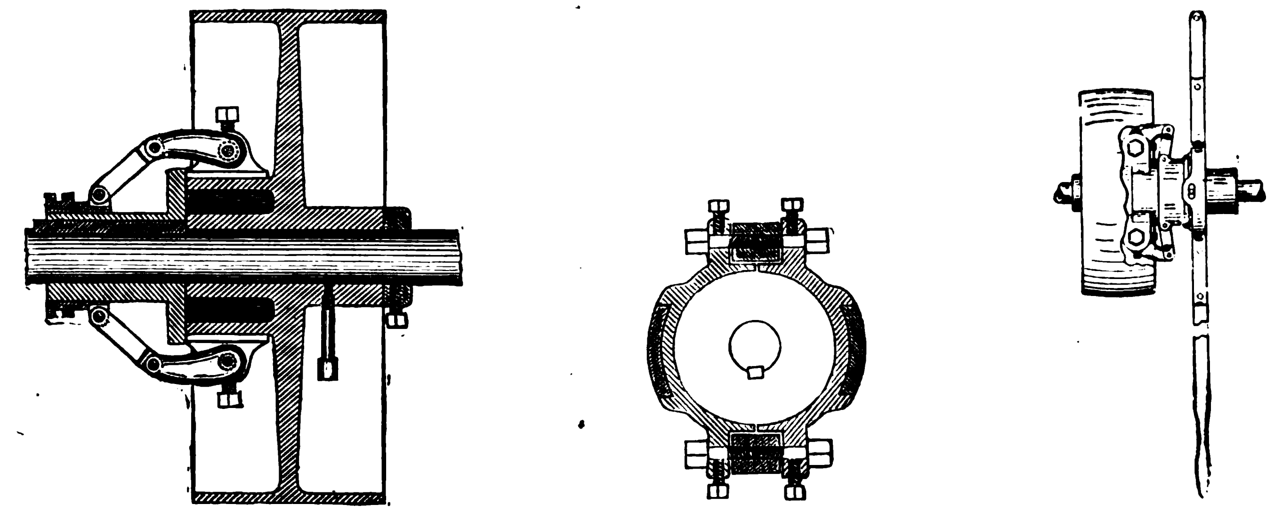


FIG. 1. FIG. 2. FIG. 3.

BARNE'S SCREW LEVER FRICTION CLUTCH PULLEY.

Fig 1 affords a sectional side view of the Barnes Screw Lever Friction Pulley in released position, showing the driving hub keyed to the shaft.

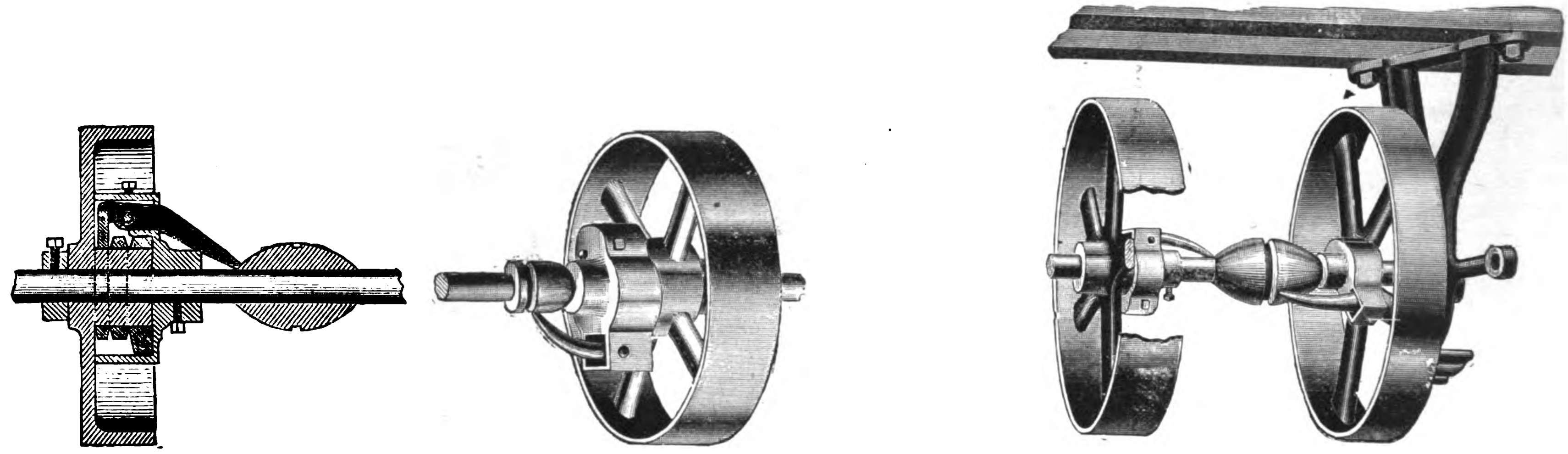


FIG. 4. FIG. 5.

BARNE'S PATENT SINGLE LEVER FRICTION CLUTCH PULLEY.

Fig. 2 is a sectional end view describing the friction hub encircled by friction-ring, the former of which is cast in one solid piece with the pulley. Projecting lugs on opposite sides of the driving hub of the ring drop into lugs, or lug cavities, of the friction-ring; and when the clutch is on these lugs take all the driving power. This is an improvement over the old bolt fastening system, the bolts of which are more liable to be affected by the twisting strain upon the hub from the friction of the clutch. At the extreme top and bottom of Fig. 2 is shown a view of a simple device which evades the use of much complicated machinery and more than substitutes the corresponding complex parts of some previous inventions. It is a lever nut on each side of the friction-ring, one-half of the nut being cut with a right thread and the other half with a left thread. Sufficient space between opposite sections of the ring is given for contraction or clutch, which is effected by means of right and left thread screw-bolts entering the lever nut from opposite sides, secured by set-screws. Duplex levers are attached to these nuts at their upper section and to the hub at their lower section. When the shipper sleeve is thrown against the flange by the operating lever, the duplex lever turns the nut sufficiently to produce a friction that was never known to lose its grip, nor has a thread of these screw-bolts ever been known to break. The screw-bolts are adjustable to any desired pressure, however, in case the clutch should ever become lax. They give the pulley a positive grip and absolute release from the hub by each opposite shift of the operating lever, without the use of springs. The Barnes Screw Lever Friction Clutch Pulleys and cut-off couplings are adapted to both heavy and light work.

Fig. 3 shows the operating lever attached to the shipper sleeve of the Friction Clutch Pulley as it appears on the shaft when complete.

Figs. 4 and 5 represent the Barnes Single Lever or Multiband, Friction Clutch Pulley, which is very efficient for light or countershaft work. The friction-ring of this clutch is merely a spiral band, which closes by traction pressure at the ends. To get the power a shipper spool on the shaft is forced under the cam lever, the wedge fulcrum end of which comes between the cylinder and a wedge-shaped projection of one end of the friction-ring, the other end of the ring resting against an adjusting set-screw, which gauges the pressure of the friction-ring.

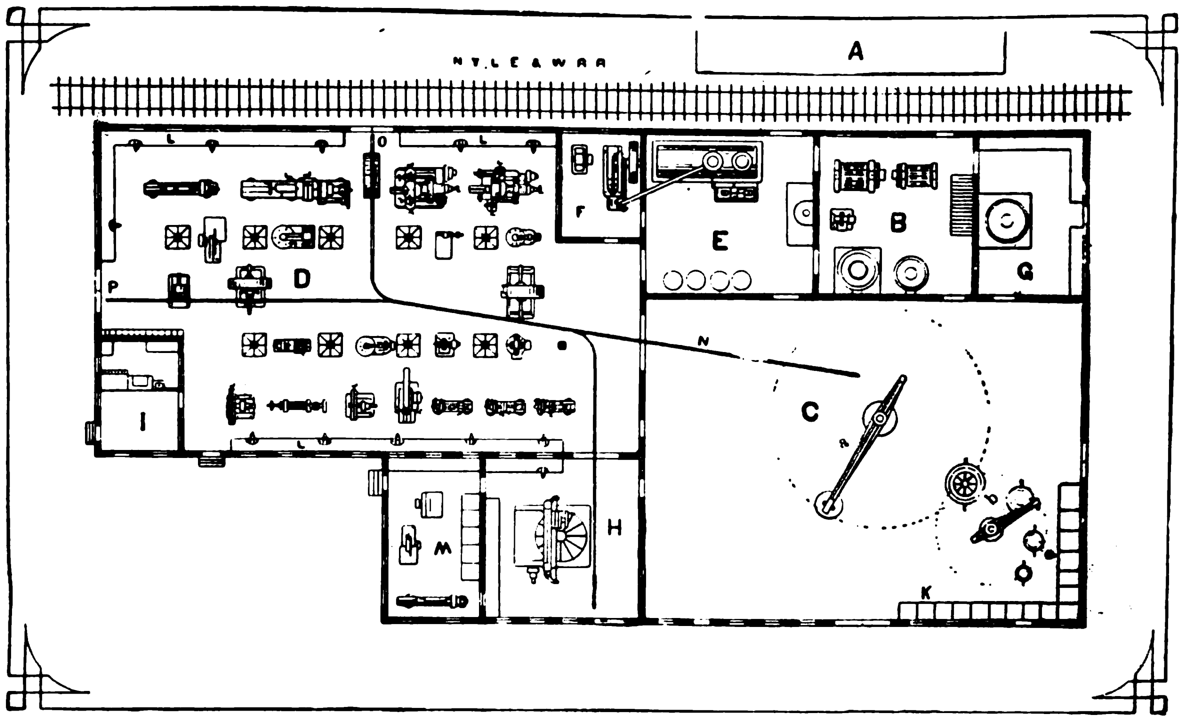
The main advantages of the Barnes clutch pulleys are simplicity and ease of adjustment. With all their efficiency there is nothing to break, nothing to get out of order by ordinary use. Both the clutch and the cut-off are effected with perfect ease by an operating lever of any length required.

The J. H. & D. Lake Company of Hornellsville, N. Y., who control the Barnes patents and manufacture, both the screw lever and single lever friction clutch pulleys, became a corporation under the laws of New York on June 10, 1892, since which time they have built up an extensive and fast-growing business.

The internal design of their buildings, which are still in process of construction and arrangement of departments, is such as might be profitable for mechanics to study. Therefore we give herewith the ground floor plan, showing how the raw material is conveyed from cars and the yard elevator to the cupola, the molten iron taken from the cupola by a crane of 6000 pounds capacity, and thence the castings conducted in a cooled state to any portion of the works by an overhead tramway. A 2000 pound crane in the molding room is used for handling the flasks. The daily capacity of the foundry is 20 tons.

The following may serve as a key to the cut of ground plan:

A, storage of coal and raw material; B, cupola, rattler and emery room; C, foundry; D, main machine room; E, boiler room;



GROUND PLAN OF WORKS, SHOWING HOW MATERIAL IS HANDLED.

F, engine room ; G, case-oven ; H, large boring mill ; I, office ; K, molding machinery shelving ; L, work benches ; M, pattern room ; N, overhead tramway; O, rail exit; P, dray exit; a, 6000 lb. crane; b, 2000 lb. crane.

The factory is now lighted by an incandescent electric plant recently put in.

The following are a few The J. H. & D. Lake Company's customers:

Niles Tool Work, Hamilton, Ohio; Gordon Steam Pump Co., Hamilton, Ohio; H. W. John's Mfg. Co., New York; Dayton Malleable Iron Co., Dayton, Ohio; Wrought Iron Bridge Co., Canton, Ohio; Avery Stamping Co., Cleveland, Ohio; Francis Fritsch Mfg. Co., Cincinnati, Ohio; Baker Bros., Toledo, Ohio; W. E. Caldwell & Co., Louisville, Ky.; Smith's Silk Machine Tool Co., Kenton, Ohio; Bardon's & Oliver, Cleveland, O.

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MACHINE SHOP NOTES.

The question of mechanical apprenticeship is worrying many worthy people—unnecessarily, for there is no dearth of good mechanics, either in America or elsewhere. This state of facts is not denied, however, by those who most concern themselves about the case, but still they fret because mechanics are mostly of foreign birth and these foreigners will not permit an American boy to learn a trade. They should state the whole truth, and that is that these workmen do not want boys of any nationality, American or otherwise. There is no trade in the country that is not more or less overcrowded, and for every vacancy there are many applicants. This condition results of course in destructive competition that affects wages unfavorably. Then why this solicitude for the American boy? Are we anxious to put our sons into trades that already are more than full, where they will be obliged to compete with European mechanics accustomed to habits of life less expensive than the standard which has been established in this country? The reason that the mechanical trades are overcrowded by foreigners is not that American boys are excluded from apprenticeship, but because these foreigners are frantically invited to our shores, enthusiastically welcomed, and when they arrive are given work in preference to Americans because they work for less money. That is the whole situation.

⁂

A peculiarity in the labor agitation which no one has appeared to notice is that no matter how many workmen we may absorb from Europe, no matter how many go to Australia, Asia or Africa or into the European armies, there is no complaint that any country is suffering from lack of hands skilled to do its mechanical work. On the contrary, there are always "hordes of underpaid and underfed paupers" still there to compete with us. Is there really any country where on the whole there is a demand for mechanical laborers that is not more than met by the supply?

⁂

The end thrust given to a spindle by a milling cutter having spiral teeth is very great, and it has a serious disturbing effect on the bearing of the spindle. The spiral arrangement of milling-teeth, however, is the best one known to produce a surface and to obviate the succession of blows on the work due to teeth cut parallel with the center of the arbor and placed at right angle with the feed. In a study of means to overcome this objectionable end thrust three suggestions present themselves. The first is to place the work platen slide at such an angle to the cutter-spindle as to neutralize the angle of the spiral on the cutter, and thus meet one thrust with an equal counter-thrust. The objections are that the cutter would need to be longer and that the cut would consume relatively more time. Another suggestion is to make the cutter the frustrum of a cone having an inclination with its center equal to the angle of the spiral, and thus oppose two thrusts that are equal. This really would take a shorter cutter than a cylindrical one, and not be a difficult one to make with modern tools; neither would the cut be materially lengthened. All toolmakers, again, know that angular milling-cutters produce very satisfactory surfaces. The other suggestion is to make cylindrical cutters of two parts, one part to be a right-hand spiral and the other a left-hand spiral. The ends of each tooth on cutters of the same sizes in pairs should clutch each other wherever they abut, so as to break joints and prevent a ridge on the work. This may be done either by cutting away 1-16 inch from the end of each alternate tooth on both cutters, or by cutting as much out of each tooth on one end as will admit one-half of one tooth on the other half cutter. An overhang usually is turned for this clutch in making the cutter blank. It is not material whether the spiral retreats toward the middle or away from it.

⁂

One of the things that Jack Swifter learned from the new toolmaker is that many of the holes in a drill jig may be transferred in a drill press directly from a correct model much better and more quickly than they can be laid out and bored on a lathe or anywhere else. The trick is a very simple one, but it is surprising how few toolmakers have mastered it. When the body of the jig has progressed so far that its seat and stops are finished and it will receive the model or similar stock part and properly position, locate and fasten it, and when also its supports or feet are made so that it will set on the table of a drill press properly, the model is fastened into it by temporary clamps in such a manner as to expose on its free sides the open ends of all the holes possible. Then with suitable drills, properly provided with sleeves to protect the holes in the model, all these holes are located to a depth slightly greater than the lips of the drill into the body of the jig. It frequently happens, however, that holes cannot be located thus, their positions being such as to forbid the introduction of a drill from their back ends ; for instance, the hole may not be drilled entirely through the model. In such cases the clearance hole is laid out with an approximation to correctness and made with an ordinary drill. When all the holes are located by one or another method, they are drilled through the jig by drills somewhat larger than the model holes, the model being removed to permit this. Then the model is returned to its seat with superlative attention to cleanness, position and fastenings, and the jig is placed on a drill press which has its table square with its spindle. Then with counter-bores having stems or "tits" long enough to extend all the way through the clearance holes that have been drilled in the body of the jig and well into the model before the cutting lips can come down to the jig —which "tits" must fit the holes in the model quite snugly—the holes from the model to the body are bored to the required sizes very carefully. Care must be had to place the holes in operation exactly in alignment with the drilling spindle.

⁂

The value of mechanical dogmatism may be indicated thus : If an ordinary drill, such as is used for iron and steel, were now made for the first time and not experimentally tried but examined instead by a theorist for efficiency, the verdict certainly would be that it could not possibly bore into metal unless it could follow a hole previously made, as large as its point, and that it could not be located in one position long enough to center it for drilling a hole. The point of a drill is a solid angle, about 120° in modern practice, and usually, at its best, is no shorter on its edge than one-tenth of the diameter of the drill. This blunt angle in drilling must grub or push its way into the solid metal under the most unmechanical of circumstances and within conditions unlike those of any other mechanical operation. Looking at it as a chisel, the angle of 120° is a very blunt one, and as such has but very small penetrating power. Looking at it again as a cutting or scraping tool, the angle of 30° rise for a cutting edge is absurd. The combined effect, however, in a drill of this edge simultaneously penetrating by pressure and cutting by revolution is so satisfactory as neither to give occasion for complaint nor to demand a more efficient substitute.

⁂

I have found it possible to make a very perfect plane of hardened steel, and also to make a ball that is a satisfactorily perfect sphere of the same material, which ball was designed to roll without resistance and every time that resistence is an atom of dust. I find it to be absolutely impossible to get and keep so small a face as a half-inch square perfectly clean one instant of time in any place where it is possible to experiment upon it.—[A. D. Pentz in Engineering Magazine.

◆

CHANGES IN VOLUME OF STEEL DUE TO HARDENING.

This is an experiment to find by measurement the effect of repeated hardening upon three pieces of steel containing different amounts of carbon.

A hole about .75 inch in diameter was drilled in the middle of each piece. The measurements were taken by means of a tapered plug. The difference in the distance to which it entered in each case, after the first and subsequent hardening was measured by micrometer. The left-hand columns give the numbers of the successive hardenings. The other columns show the changes in the diameter of the hole. The first piece, of carbon .848, showed contraction of the hole every time it was hardened except the sixth, and the piece cracked at the seventh hardening. The operator supposes that the sixth hardening was accidentally omitted.

CHANGES IN VOLUME BY REPEATED HARDENING.

Number of times hardened	Nos. 6 and 7, Table I. C — about .848.	No. 4. Table I. C — .649.		No. 3. Table I. C — .529.	
	Contraction of hole.	Expansion.	Contraction.	Expansion.	Contraction.
1	.00172	......	.00257	......	.00086
2	.00172	......	.00086	......	.00172
3	.00688	......	.00482	......	.00000
4	.00688	......	......	.00172	......
5	.00688	.00172	......	.00086	......
6	.00000	......	.00172	.00086	......
7	.30044 cracked	not cracked	.00000	not cracked	.00086
Total change	.02752	......	.00771	.00000	.00000

Hole was originally .75 diameter.

The second piece of carbon .649, showed contraction three times, then no change. Then an expansion of the hole followed by a contraction, and the seventh time there was no change. This piece did not crack.

The third piece of carbon .529, showed two contractions, then no change, followed by three expansions, and seventh a contraction. This piece did not crack.

The total changes are quite marked:

Showing for carbon...............848—.02752 inch.
" " "...............649—.00771 "
" " "...............529—.00000 "

This shows in another way that steel of high carbon changes more in volume per degree of temperature than steel of low carbon.

The high steel cracked, the low did not. All the pieces were of the same quality.

The experiment recorded in this table forms no part of the investigation by Prof. Langley and ourselves. It was made rather crudely for a practical purpose, and the results obtained in practice confirm the figures in the table.—[Sparks from Crescent Anvil.

◆

$720,000,000.00 represents the aggregate capital invested in the electric industries in the United States, according to the estimates of recent date. About half of this amount, $350,000,000.00, gives the proportion which electric lighting and power have attained.

METAL CUTTING TOOLS.—III.

(Continued from first page.)

it is working properly is by the sound and feel of the tool or tool post. If it cuts quietly and without "chatter" or vibration, it is reasonably sure to be cutting all right. If, on the contrary, it groans and rattles, and makes everything on the lathe to dance and jingle, be sure that it needs looking after. One great source of difficulty with small, deep bores is the fact, in order to make the tool sufficiently stiff to enable it to cut without undue spring, the bar or body must be made so large as to render it very difficult to make it clear the hole. It will touch either on front or back or, unless set very high, at the bottom, and as it is rather difficult sometimes to perceive this, the result is apt to be a very crooked hole—may be a spoiled one before the trouble is detected and remedied. While such an occurrence may, strictly speaking, be called carelessness, it is not so very careless after all, as it not infrequently happens, even to very careful workmen.

To avoid such a contingency, as well as for every other economic reason, the ordinary form of forged boring tool should never be used for small bores of any considerable proportionate depth. Instead, have the forged portion turned straight and parallel with the bottom of the bar, by which it is set and held in the tool post. Across the end of the turned portion cut a dove-tailed slot, into which is firmly driven the cutter or tool point. This should be made as long as will clear the back side of the bore when the point is set as far forward of the front of the bar as will just enable the latter to clear the chips, which are apt to be carried around as the bore revolves and cause the tool to spring off. The cutter should be hardened uniformly its entire length, and when used up by wear and grinding is easily replaced, and at much less expense than that of dressing the ordinary tool as often as would be necessary to do an equal amount of work. Then, too, cutters of different forms, suitable for every necessary variety of work, may be used with the same tool stock, and not only effect a great saving of expense, but enable the workman to very soon collect a very large assortment, which occupy but little space and are always available.—Iron Age.

◆

THE HICKS GAS AND GASOLINE ENGINE.

(Illustration on first page).

Our illustration shows a new gas and gasoline engine invented by Mr. John B. Hicks, and manufactured by The Hicks Gas and Gasoline Engine Co. of Cleveland, O.

In a gas engine, the combustion of fuel takes place directly in the cylinder behind the piston, and its full effective heat energy is utilized in the expansion of the air with which it is mixed. In all gas engines prior to this time, only one effective stroke or thrust of piston has been obtained for each two revolutions of the crank shaft, one revolution being devoted to filling the cylinder with the explosive compound and compressing it, and another to igniting and expanding the gases behind the piston, and then forcing them out of the cylinder preparatory to drawing in a fresh charge. Thus it will be seen that out of the four movements of the piston, down, up, down, up, only one has been effective in delivering power to the shaft. In all these engines, it has been necessary to maintain a constant flame or jet of fire to ignite the charge at the proper moment, involving the use of delicate machinery to control and admit the flame, to fire the charge behind the piston.

In the Hicks Gas Engine, two cylinders set in line are employed to work alternately, their pistons being on one piston rod, to which an effective impulse is imparted for every revolution of the crank, doubling the power of the engine while adding only the weight of one cylinder and piston, (a very small percentage of the whole weight of the engine). By thus doubling the number of effective strokes of the piston a very much lighter balance wheel may be used with good results. The operation of the engine is as follows: The gas throttle valve being opened, turn the fly wheel by hand once or twice and the engine will start into full operation. At the first downward movement of the piston the explosive compound will be drawn into one of the cylinders, say the upper one, through the valves, which then close and prevent its flowing back into the pipe as the pistons make their up stroke. While the compound in the upper cylinder is being compressed in the upper end of the cylinder the crank shaft passes its upper center, the charge in the upper cylinder is exploded and the expanding air and gasses drive the piston down rapidly and start the engine. When the piston has completed its downward movement and starts upward, the upper escape valve is opened and the burnt gasses in the cylinder allowed to escape. On its next downward movement, the piston again draws in a fresh charge of the compound which is compressed and exploded as before. When the pistons are descending under the impulse of the explosion in the upper cylinder, the lower cylinder is drawning in its charge of the compound to be compressed and exploded, while the upper cylinder is being cleared of the burnt gasses and recharged, the two cylinders thus working alternately. Many advantages over other gas engines are claimed. A great deal of valuable information concerning this machine and the principles of gas engines may be procured from a pamphlet "A Word to Power Users," which is sent free to any address by The Hicks Gas and Gasoline Engine Co., whose address is given above.

◆

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◆

BALDWIN'S VACUUM BOILER TUBE CLEANER.

(Illustration on first page).

The illustration represents the method of using a new appliance, with which tubes of boilers are cleaned by a new principle. By its use a draft of great velocity is formed in the tubes to which it is applied and the soot is drawn from the tube and sent up the chimney, where it should have gone at first, thereby obviating the necessity of shoveling it out of the back connection—a dirty job which no engineer or fireman likes.

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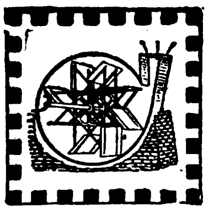

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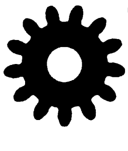

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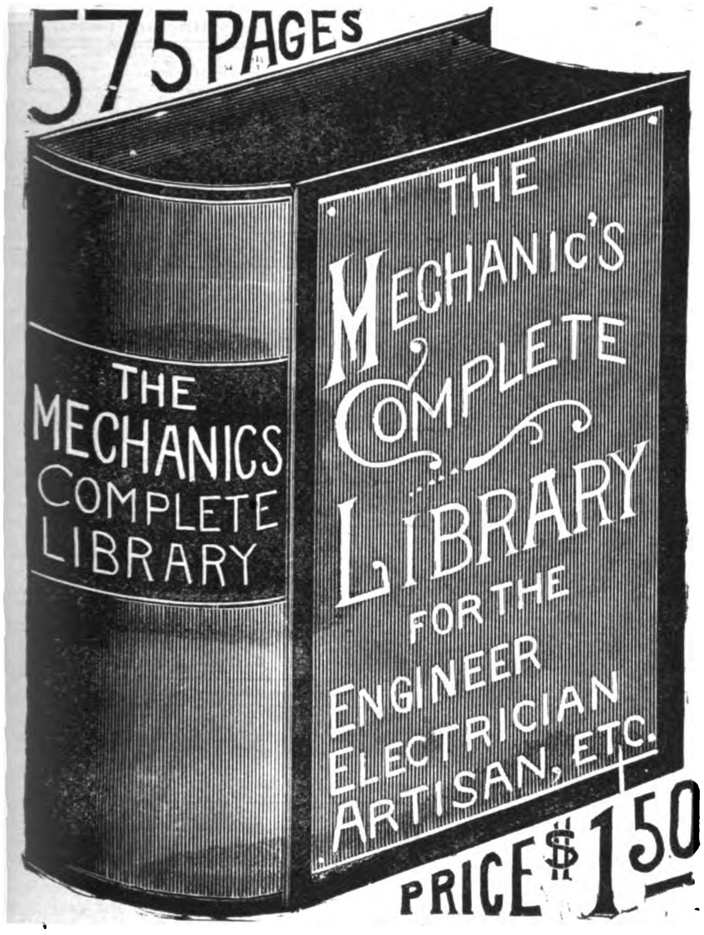
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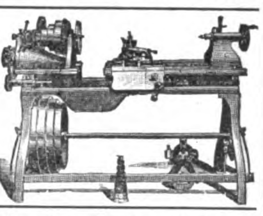

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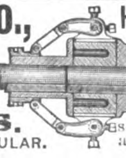

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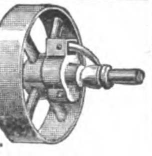

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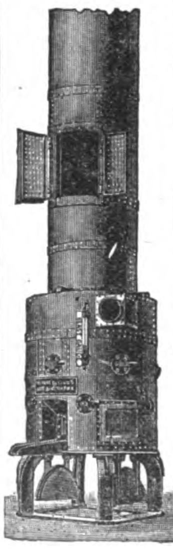

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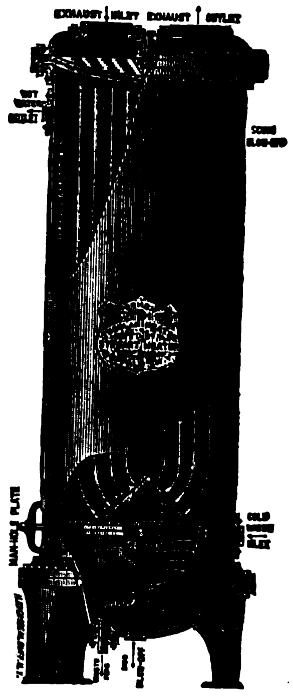

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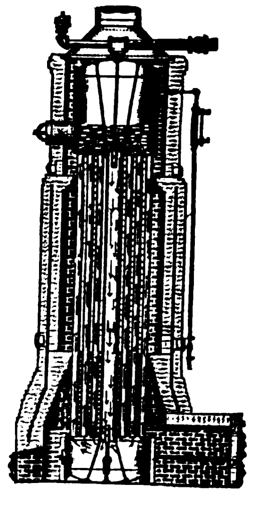

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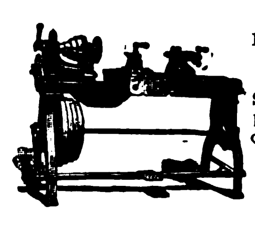

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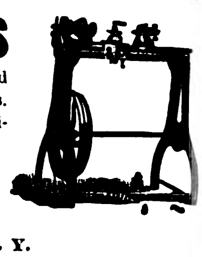

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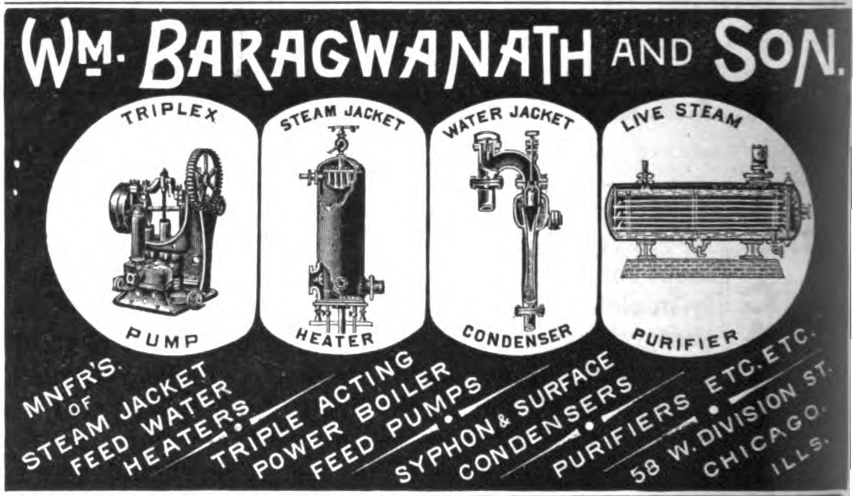
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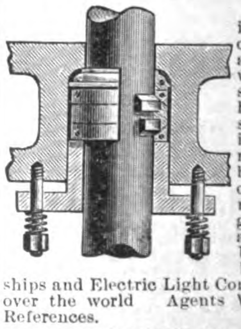

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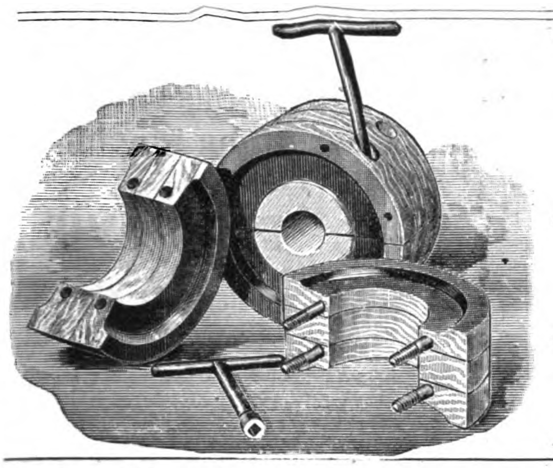

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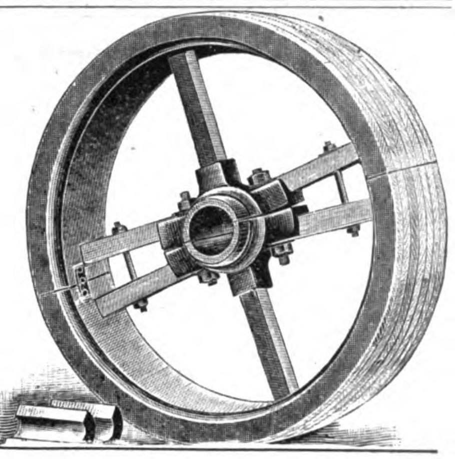

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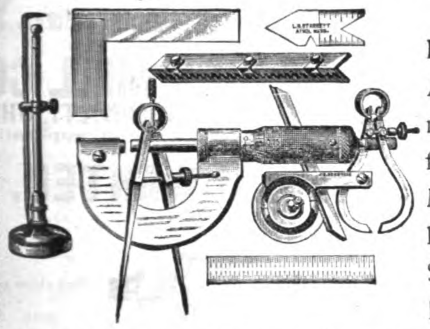

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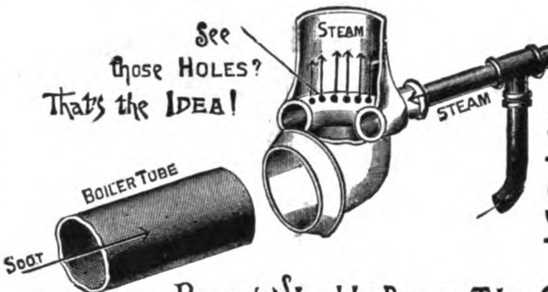
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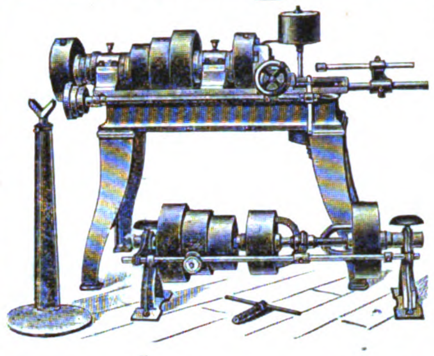

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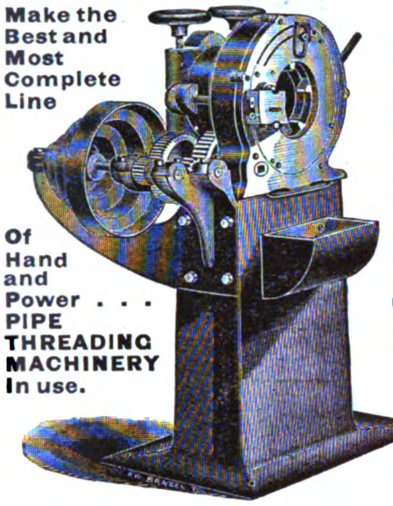

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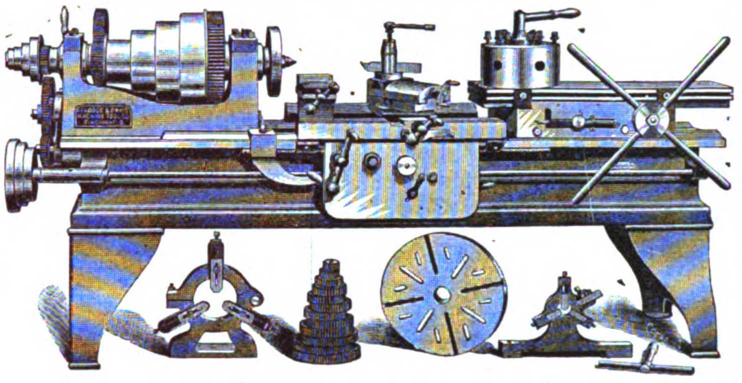

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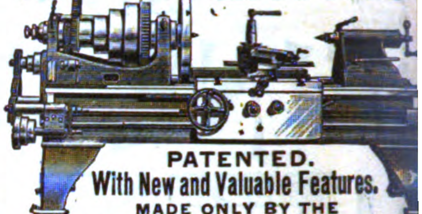

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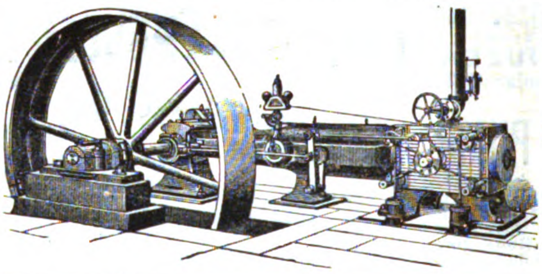

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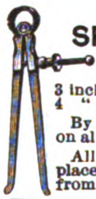

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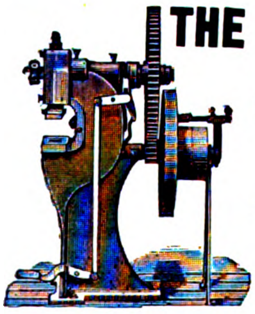

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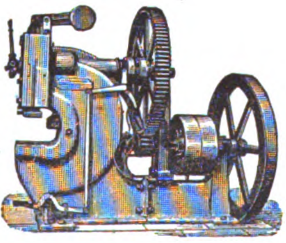

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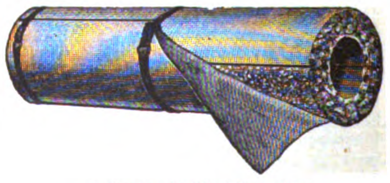

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SCIENTIFIC MACHINIST

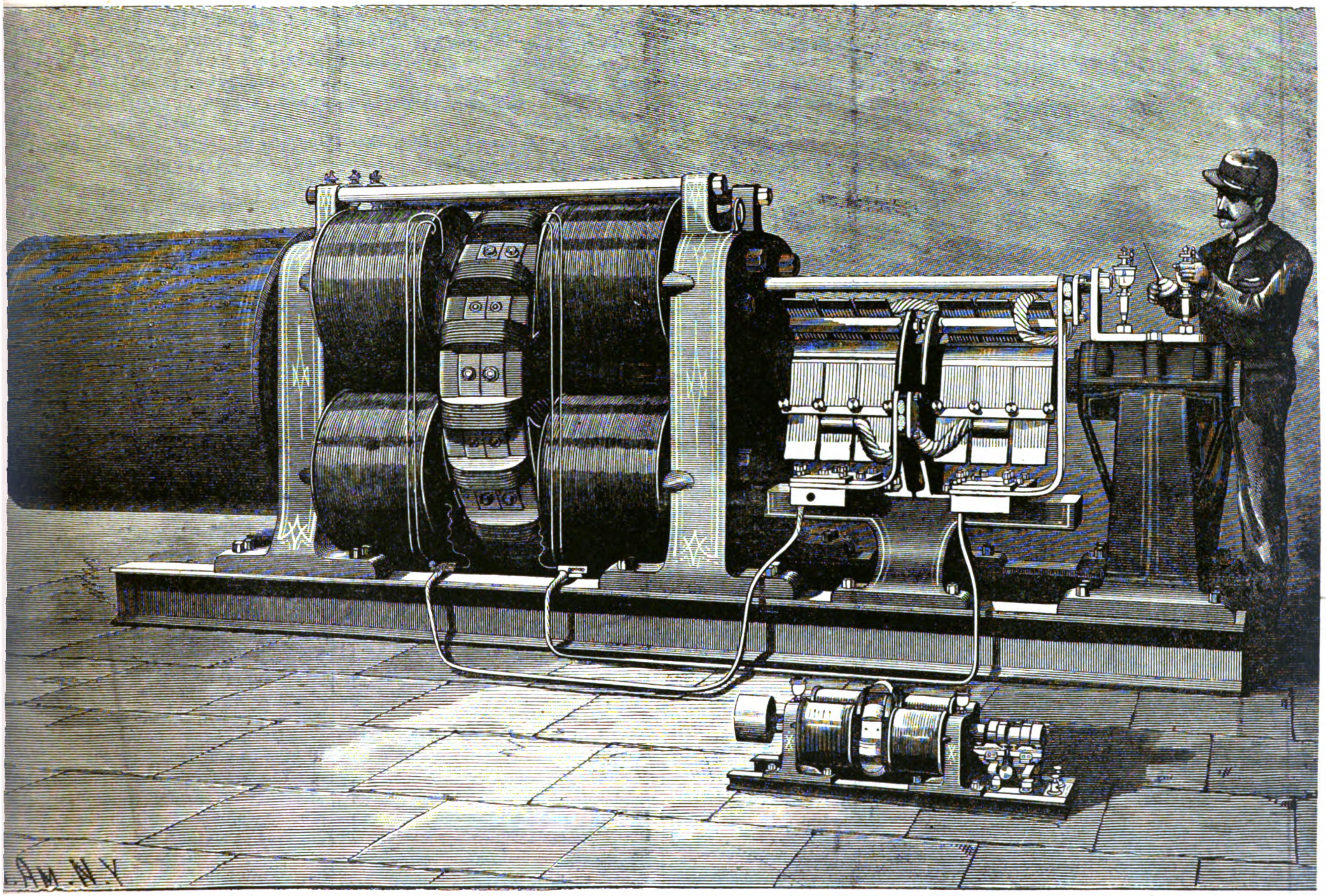
TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES

ESTABLISHED 1882. CLEVELAND, O., NOVEMBER 15, 1892. VOL. 10—NO. 22. PUBLISHED SEMI-MONTHLY. SOLD BY NEWSDEALERS. Terms:—$1.50 A Year. Single Copies, 7 Cents.

LARGE DYNAMO FOR SMELTING ALUMINUM.

Aluminum is one of the most useful of metals and its evolution has been of great interest to the scientific world. Its rapid drop in price from a few years ago has greatly extended its use. The cheapening of the metal is due to improvement in smelting and reducing it. The process is quite different now from what it once was. We have published from time to time articles describing the making of aluminum and presented cuts illustrating the process.

We give on this page an engraving of a dynamo used in smelting aluminum at the Lockport (N. Y.) Works. It is probably the most efficient machine ever built for this service. It was built by the Brush Electric Co. of Cleveland and is called the "Brush Colossus Dynamo-Electric Machine." Its capacity is 5,000 incandescence lamps of 16 candle power each.



LARGE DYNAMO FO SMELTING ALUMINUM.

Cement for Joints.

A German inventor, says an exchange, has discovered that Portland cement can be used as a substitute for rubber and asbestos preparations in the packing of steam-tight joints. From extensive practical trials this cement packing is found to be quite as efficient as the others hitherto employed, and its cost is only a tenth of that of the others. The cement is made into a paste with water and spread in a layer from one-fifth to one-half inch thick over the surface of the metal. The plate or cover to be fixed is then placed in position and the screws are simultaneously screwed down very slowly. After the layer has been compressed to about one-eighth inch in thickness the screwing is stopped and the cement is allowed to harden for four hours. The screws are then turned further and the edges plastered again with cement. The joint is completed in eight hours after the making of the cement. This joint is certainly cheaper than those made with rubber or asbestos, but the time wasted in making it by this process is out of all proportion to the saving in first cost effected by its use.

Another cement is given for steam pipes to fill up little leaks, as a blow hole in a casting, without removing the injured piece. The cement is composed of five pounds Paris white, five pounds yellow ochre, ten pounds litharge, five pounds red lead, four pounds black oxide manganese. The whole is to be well mixed and a little asbestos and boiled oil added. This cement will set hard in from two to five hours and is not subject to expansion and contraction to such an extent as to cause leakage afterward. Leaks that occur in places which are difficult to get at and remedy may often be stopped by the application of a little cement, composed of the above materials, in about the proportions specified. This is well worth trying.

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The Convertibility of Speed and Power.

Sir R. Ball remarks in relation to the most general and obvious means of conveying power from motor to machine—the common leather belt—that a light, fast running cotton rope may be substituted for the heavy, slow-running belt, when the conditions are favorable to the exchange of speed for weight. Following up the line of reasoning thus presented, Sir R. Ball shows that a rope as light as sewing cotton, running at the speed of a rifle bullet, would carry a horse power. Proceeding to the extreme case of the lightest kind of line known (that of a spider's web) and the highest known velocity of travel (that of light), Sir R. Ball arrives at the astounding conclusion that if a line of spider's web could be driven at the speed of light it would carry something like 250 H P

ELECTRICAL

Electricity and Conjuring.

The French Government, in the year 1856, found that in Algeria the natives were being incited to rebellion by the pretended miracles of their priests. Robert Houdin, the most celebrated conjurer of the time, was invited by the Government to visit that colony and try to outdo the native fakirs and conjurers. He finally succeeded, after many amusing experiences, in quelling the revolt, through the superstitious fears of the natives. He employed electricity in many of his feats, and in one particular he used a chest which had an iron plate in the bottom. This chest he placed upon a box in which was concealed a powerful electromagnet. By means of a simple, hidden device he controlled the current with his foot. He declared that he could, at will, make the strongest man a weakling. Several powerful natives were invited to lift the chest when the current was turned on, but naturally they did not succeed. Houdin called up a little boy. Secretly breaking the contact, the child easily lifted the chest. The native conjurers confessed themselves outdone. At the present time we have but few good conjurers in this country.

Wishing to learn what is accomplished by electricity in this art, I resolved to "beard the lion in his den," and interview Prof. Hermann.

I must confess that it was not without a certain feeling of awe that I presented myself at the little latticed window, presided over by a corpulent Cerberus, and handed that gentleman my card, upon which was written: "The Electrical Review would like to interview Prof. Hermann concerning his wonderful applications of electricity to his profession." After some time the Professor appeared.

"Realy, I am very busy," said he, "and you must excuse me, for I have an appointment at this hour, so I must leave you; but, before I go, I will introduce to you a gentleman who knows more about the subject of electricity than I do, for he has been with me ever since I started in this business."

The Professor then introduced me to this gentleman, who proved to be his business manager. My confusion nearly overcame me, for I imagined that now I was to be initiated into the wonderful mysteries that are nightly performed in the little Temple of the Sphinx on Broadway. My mind's eye pictured to me quantities of the electric fluid under the controlling thumb of the mighty Hermann, and information seemed to be hanging in festoons from all parts of the business manager. Thinking that it would only be by strategy, if anything, that I could obtain the much coveted information relating to the use of electricity for conjuring, I put on my most insinuating manner and prepared to interview.

"I have seen your card," said he, "and I presume that you want to interview me concerning the electricity that we use."

"You have guessed correctly," I responded; "that was my purpose in coming to see Prof. Hermann."

"Well, you know that we use electricity all the time, and some of our most important tricks are done with the fluid. Hermann has a watch—I am sorry I can't let you see it; but it is so valuable that he never lets it leave his person, except when he has it locked up at home. It is a wonderful piece of work. It is not exactly a watch, but nothing more than a powerful machine capable of generating about one horse-power of electricity, very ingeniously contrived and concealed in the case of a watch."

Imagine my surprise when I heard that there was such a machine in existence and that the Electrical Review had heard nothing about it. Would it be possible for me to see that machine and get a photograph of it, I asked.

"No," he replied, "the Professor never lets anyone see it now, but I can give you a description of it."

As I thought it would be a pity for the world to lose such a wonderful piece of mechanism, should any accident happen to it, I prepared my note book to write an accurate description, so as from the word picture, to make a working drawing.

"In the first place, the machine was made in Europe—they can't make such things here—and it is guaranteed to give only one horse-power, but I really think that it will give much more. Of course, you understand, it has never been used to give more, but I really believe that if it were put to the trial, one horse-power of electricity would be the minimum amount evolved. But I suppose that you are anxious for the description of the works. Inside of the case is an armature, some coils of wire, a few magnets, a lodestone—I suppose that you know what a lodestone is?"

I signified in the affirmative.

"Then there are some push buttons, a dial with some numbers, some switches, and a few other things, and that's all that I can remember about what is inside of it, but I suppose that I have told you enough to enable you to understand the workings of this wonderful watch."

"You say," I asked, "that all those things are in the inside of that watch case, and that such enormous power can be obtained from such a small thing?"

"Yes," he answered, "and I doubt whether the instrument could be replaced if it were lost."

"How is the current carried from this powerful machine?"

"Oh, that's easy enough. You know that ordinary people use wires for carrying the current, but Hermann does not; he uses black silk threads, and when he wears trousers of the same color and has a black carpet upon the stage, it is impossible to see them. The current goes through these threads, and he can do marvellous things upon the stage while he is in the audience, and no one suspects that he is doing anything."

"This is truly wonderful," I answered. My eyes are daily opened to new wonders. But I had a doubt in my mind at that time, whether the horse-power that the gentleman referred to was a hobby-horse or a clothes-horse power. Up to the present moment I have not as yet decided.

"Are many of his tricks done by the aid of electricity?" I again asked.

"Why, his most wonderful tricks are done by the aid of the fluid. Have you seen 'Cremation?'"

"No."

"Well, how could that be done without the aid of electricity?"

"Not having seen it I cannot say."

"Have you seen 'Ya-Ko-Yo?'"

"No."

"Well, how could that be done without the aid of electricity?"

I again confessed my ignorance of the manner of performing the trick.

"Don't you see? How could we do without electricity? It would not be impossible, but it would be extremely difficult. The fluid is of the greatest assistance to us. In some of our tricks we could not do without the telephone. For instance in one of Herman's seances, he holds a photograph at one end of the telephone while he stands in the orchestra, and a reproduction of the photograph is seen on the stage in midair. You know that this transmitting of images by means of the telephone was invented by Garner, and we have used it in many of our tricks."

"Have you ever seen this instrument?" I asked.

"No," he answered, "But there used to be one of them in the theatre. It was a wonderful instrument and astonished all who saw it."

"Then you say that a 'telephone for transmitting images' has reached a state of perfection. I wonder that Prof. Hermann has not placed it upon the market and realized a fortune."

"That's just it. I have told that to the Professor. But you know what these magicians are. If they would show these things to the public they would cease to be of interest to the large audiences that he draws nightly. And it is this diffidence that has kept many great inventions from the world."

"I did not know that the Professor was an inventor."

"Yes, indeed, he has invented many wonderful things, but he has kept them all to himself."

"Is there anything else electrical of interest, of which you can tell me?"

"I am sorry I cannot take you behind the scenes, for we have the most complete system in the world for lighting our theatre. Every light can be turned on and off, and there are push buttons and switches everywhere. The stage is a perfect network of wires, and you cannot look anywhere without seeing them hanging in all directions."

"It is truly wonderful. I am greatly obliged to you for your interesting information. Good afternoon."

I walked out into the busy thoroughfare, thinking that great are the uses of electricity, and fully agreeing with Shakespeare, that
"There are more things, in heaven
and earth, Horatio,
Than are dreamt of in your philosophy."

—[Julian A. Moses in Electrical Review.

Electric Torpedo Boats.

The torpedo boat is one of the weapons upon which we are to rely in the next great naval war, and men-of-war are provided with second-class torpedo boats, which are to be hoisted out and detached when occasion arises. It is obvious that one of the great requirements for boats built for this service is that they should be always ready for work. With a steam launch some delay must be incurred in raising full pressure of steam, even if the launch boiler be fed with live steam from the main boilers. The electric torpedo boat can be charged from the dynamo, which is now a necessary part of every steamship's outfit, during times when there is slackness in the demand for steam and when few lamps are switched on.

The cost of the charging is therefore reduced to a minimum, but this recommendation is one of the least important because in estimates for war purposes economy is a very secondary consideration. The great recommendation is that she is always ready. Once charged she remains on duty, and when the call comes she has to be put afloat and the starting leaver put over. She is thus enabled to go full speed ahead on touching the water, and this is a very great consideration. The difficulty at present in the way is that of speed. The data available to the public respecting small steam vessels is very meager. We can easily find out particulars of engines, consumption, and capacity of ocean steamships, although sometimes the figures are mere approximative; but the builders of little boats keep the particulars of weight of machinery and amount of consumption of coal very much to themselves. Then, too, the electric launches hitherto built have not gone in for great speed.

Those built for pleasure purposes, for example, are limited in speed, and the builders of craft for this traffic are therefore obliged to find an outlet for their ingenuity by trying to decrease the weight of their machinery and increase the length of time during which a vessel may run before her charge is exhausted. Thus at present we cannot pretend to give any accurate details regarding the weight of electric machinery to drive a second class torpedo boat at the speed which her steam engines now take her. This, however, seems certain—she could be driven at her present speed in the present state of electrical science, though her endurance would be less with electricity than with steam. This is, of course, a disadvantage, but it must be remembered that in an attack by a boat of this kind, detached from a man-of-war, the time during which she would be re-

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quired to be under way would be very short.

The attack would probably consist of a rush forward and a rapid retreat to the shelter of her convoy. Against this disadvantage must be placed the constant readiness to which we have already alluded, and also another advantage, which is of scarcely less importance viz., the absence of smoke and glare. During the recent naval maneuvers it was a constant complaint that when pressed to full speed a flame appeared above the funnels of the torpedo boats in spite of all efforts to prevent it, and that this, of course, gave fatal indication of their whereabouts. The whole value of an attack could be lost if such a warning were given in actual warfare, and the electric launch could give no such sign.

Telegraphy at Sea.

Says Prof. W. W. Jacques, in a lecture recently delivered in Boston: "Another invention that must soon become one whose underlying principles have been already worked out—an invention that is only waiting for some ingenious inventor to make, is a good method of electrical signaling between two vessels approaching each other in the midst of a thick fog at sea.

"Let us imagine such a device applied to two ocean greyhounds approaching each other with a combined velocity of 40 miles an hour through a heavy fog in a dark night. The lights are useless, for even an electric search light will not be visible a mile away. The steamer's whistle is useless, for the fog soon absorbs the sound; and yet these two vessels may be rushing immediately toward each other with a force and velocity that, in case they meet, shall mean total annihilation. And yet there is no need of such danger. Means of producing electrical signals on the one vessel already exist. The ocean is an excellent medium for conducting these signals to another vessel many miles away, and means on the second vessel for detecting and recognizing such signals may easily be contrived. Let us see how electricity steps in and points out a simple way by which such collisions may be avoided. Suppose each vessel to be equipped with an insulated wire running from bow to stern, but dipping into the ocean at each end. Suppose one vessel to have included in this wire means for producing strong and rapidly alternating currents of electricity. Suppose the second vessel to have connected to its wire an ordinary listening telephone. Electrical undulations will be radiated from the first vessel through the water in all directions until, reaching the second vessel many miles away, they will be heard in the listening telephone. By equipping each vessel both with means for sending out electrical undulations and for listening for any that might be received each vessel would be made aware of the approach of the other and the danger of collision avoided. But the greatest electrical harvest to be gleaned in the near future will come when some inventor or engineer devises a method of converting the energy stored up in coal directly into electrical energy."

Readers of the SCIENTIFIC MACHINIST may remember seeing in these columns some months ago an illustrated article showing how Thomas A. Edison would conduct sea telegraphy. The subject, as will be seen, has enlisted the attention of the greatest inventors and thinkers. It is very probable that some practical results will, in the near future, be attained in this field.

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STEAM PUMPS.—VII.

BY J. O. SMITH, M. E.

Having described the different classes of direct acting pumping machinery, it would be of advantage to dwell upon the motive power which drives it.

The agent which carries this motive power is steam, which is obtained by boiling water under a pressure greater than that of the atmosphere, although, in regions abounding in much water power, advantage is taken by driving an air compressor by means of a water wheel. The air is stored in a receiver from which it is conducted through pipes to the machines to be driven.

Pumps driven by electric motors are coming into use, and have the advantage of permitting the motive power to be conducted through long distances without such losses as condensation and leakage of steam, etc.; although there is a loss in converting the heat energy in the boiler into electric energy at the dynamo through the intervention of the engine.

But with the vast stores of coal in the bowels of the earth, and with the large bodies of water on the surface, the method of converting water into an elastic vapor (steam) by means of the heat obtained from the combustion of coal is more economical than any other method with which we are acquainted.

Studying the composition and properties of water, it is found that it is composed of two gases, hydrogen and oxygen, combined by the force of chemical action to form a substance (water) totally unlike either of its constituents in its characteristics, and a liquid at the ordinary temperatures while its components, hydrogen and oxygen, remain gases, and can be reduced to liquids only by extreme cold and pressure.

By burning the two gases together, the oxy-hydrogen flame is obtained, the hottest flame that is known to us, and the gases uniting in this flame form the well known liquid, water.

That water is composed of hydrogen and oxygen, may be readily demonstrated in the boiler room by taking a piece of gas pipe and bending it in a U shape, and putting in some iron chips or filings at the bend, and putting the bend in the furnace, leaving both ends sticking through the furnace door. When the pipe has become red hot, pass a jet of steam into one end of the pipe, and, as the steam comes in contact with the red hot filings, it is decomposed into its two constituents, the oxygen combining with the filings, while the hydrogen passes on free out at the other end of the tube, where it may be burned or caught under water. Very great care must be taken that all the air has passed out of the pipe before lighting, and that there is no air mixed with it in catching under water, as it is dangerously explosive when mixed with air.

Water, it is well known, exists in three states according to the temperature to which it is exposed, as a solid (ice), as a liquid (water) and as a gas (steam) and one form can be changed into the other either by giving or extracting heat. It becomes a solid at 32° by the Fahrenheit thermometer and becomes converted into steam at the ordinary pressure of the atmosphere at a temperature of 212°. It expands and contracts with heat and cold, contracting as it becomes cooler until it falls to a temperature of about 39°, when it again expands, so that when it becomes ice at 32° it floats on the surface of the water.

When heat is applied to a piece of ice, it is found, by means of the thermometer, that it remains at a temperature of 32° until all the ice is melted, when it begins to rise in temperature while heat is still applied. When the temperature 212° is reached, it begins to boil at this point and the thermometer remains stationary while heat is still applied until all of the water is converted into steam.

It will be noticed in transforming this piece of ice into steam that when the ice was being converted into water, and that when the water at 212° was converted into steam, a quantity of heat was given to the water which did not show on the thermometer; the heat which was given to the water to increase the temperature from 32° to 212° was shown by the thermometer, and, since it can be observed, is called sensible heat, while the heat which did not show itself through the thermometer is called latent, and it is regarding the use of this heat upon which the economy of the steam engine depends.

In the first place a unit must be established in order to measure this heat, and that amount of heat which is necessary to raise one pound of water one degree F. in temperature is taken as the unit.

It has been found by experiment that the number of heat units required to convert one pound of ice into water is 141; the amount of heat (sensible) necessary to raise the temperature of a pound of water from freezing to boiling point would be $212^\circ - 32^\circ = 180$ units. Now, it has also been found by experiment that, to convert a pound of water at 212° into steam requires 966 units of heat, therefore, the amount of heat necessary to convert one pound of ice into steam at atmospheric pressure will be $141 + 180 + 966 = 1287$ heat units.

We have now found the means for measuring the amount of heat necessary to convert water into steam; and, if we can find some relation between heat and work, and express that relation in units of heat, it is easy to find how many units of heat are required to perform a horse power of work.

It is evident that mechanical motion is convertible into heat, as the stoppage of a train by means of the brakes demonstrates that the motion of the train is transformed into heat; the converse is true also, as the combustion of the coal in the boiler, sets the engine in motion. The relation between heat and work has been ascertained by mathematical calculations, and verified by experiment, and it has been found that a pound weight falling 772 feet or 772 pounds falling one foot, will raise one pound of water one degree Fahrenheit; that is, 772 foot pounds is equal to one unit of heat.

With the introduction of the steam engine, Watt was obliged to estimate the power of his engines so as to be intelligeable to the people who were in the habit of doing their work with horses, so he estimated the power of his engines by horse power, and found that the average horse was capable of lifting 33,000 pounds one foot high in one minute or 33,000 foot pounds of work. In estimating the economy of a pumping engine, it is rated in the number of gallons of water raised to a certain height by the combustion of 100 pounds of coal. Of course, in knowing the number of gallons pumped, and the height to which it is forced and knowing weight of a gallon of water, it is easy to compute the number of foot pounds of work performed by the combustion of 100 pounds of coal.

To compare the actual duty with the theoretical, we take a remarkably high duty which is 125,000,000 foot pounds per 100 pounds of coal.

Now, it is found by experiment that one pound of bituminous coal contains 11,600 units of heat, hence, 100 pounds contain $11,600 \text{x} 100 = 1,160,000$ units of heat, and, since 772 foot pounds of work are equivalent to one heat unit, there are $1,160,000 \text{x} 772 = 895,520,000$ foot pounds of energy in 100 pounds of coal. The amount of water lifted by 100 pounds of coal is equivalent to 125,000,000 foot pounds of work,

$$\text{thence } \frac{895,520,000}{125,000,000} = 7.16; \text{ that is,}$$

less than 1-7 or 14 per cent. of the actual amount of power in the coal is expended in useful work.

Of course this loss of 86 per cent. is due to the imperfections of the boiler as well as the engine itself, and is hardly a fair test for the economy of the engine alone.

This knowledge of latent heat enables us to proportion the size of the water cylinders of the jet condenser, and also the amount of cooling area of the surface condenser, for, knowing the amount of steam used by the engine and the pressure at which it is exhausted into the condenser, the amount of heat required to condense the exhaust steam into water can readily be determined, and, from the last result, the amount of water necessary to keep the condenser at a certain temperature is easily obtained.

Pumps af the crank and fly wheel pattern are often used in large plants in preference to those of the direct acting type. The initial steam pressure exceeds that of the water and is cut off at an early part of the stroke, storing the excessive energy in the fly wheel to help the piston at the latter part of the stroke when the steam pressure is low.

They show a remarkably high duty, but are obliged to run at a high piston speed to sustain it; for, when the speed is reduced, steam must follow the piston farther in the stroke in order to carry the engine over the center thus making it less economical.

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LIFE INSURANCE FOR ENGINEERS AND MECHANICS.

Insurance is comparatively a modern business. It began with certain destructable property, gradually expanded until nearly all merchandise, buildings and ships were embraced and finally was extended to the protection of that most valuable energy—human life. There were many prejudices against insurances on life, when it first was started. But gradually people began to appreciate the fact that there is as much need for indemnification for the loss of earning power in human beings as in animals, machines and other property. If a man is earning and expects to continue earning a thousand dollars a year, his energies are worth one thousand dollars for every year of his expectancy. If his expectancy, based on mortality statistics, is thirty-five years, his earning power is presumably $35,000. No man would think of leaving machinery or buildings valued at such an amount uninsured. Why then, should he allow the value of his own strength and power to remain uninsured? It is his duty to his family to protect the latter as well as the former. For a man who has little else of value than his own energies to allow them to remain at risk, is much more foolish than to permit destructable property to remain so, for when he dies all the value his family possessed is swept away.

It is positively the duty of every man to carry a reasonable amount of insurance on his life, and one who possesses but little property is committing a great sin against those dependent upon him to neglect to do it.

Engineers and mechanics should attend to this important matter. There is a belief among some, that such protection is not within the reach of a poor man.

This is erroneous. No mechanic need go without it. There are regular insurance companies that will write him a policy, the premium of which he can pay if he will. There are, besides, a number of fraternal insurance concerns that offer reliable insurance at a low price.

There is a field for great usefulness in life insurance among mechanics. Associations can be formed for such purposes, embracing men engaged in certain occupations.

The National Association of Stationary Engineers has a feature in its splendid life insurance and accident department, that alone is a sufficient advantage to justify every man who can get admission to it to join. Such a large body of substantial men banded together for mutual advantage, mentally, socially and financially, make the very best basis possible for practical and reliable insurance.

The men employed in an institution hiring as many as five hundred can very easily form an insurance organization. The management must be businesslike and intelligent, and rules made to suit the peculiarities of every situation. But the constitution and by-laws of very strong fraternal organizations can be procured and from them regulations made, which, if properly executed, will carry the institution along safely.

No one can afford to be uninsured in these days.

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THEIR ENGINEERS WERE HIRED TO WORK.

THE SCIENTIFIC MACHINIST has various methods for reaching engineers with sample copies for missionary work. One is to send to concerns owning steam plants large enought to justify the belief that regular engineers are there employed, with the polite request printed on the wrapper to "please hand to the engineer."

The attitude of some manufacturers and plant owners to the science of engineering and to education in that line is shown by the treatment they accord such copies.

We received back in one year, about a hundred copies with remarks written on the wrappers expressing, some fiercely, some mildly, but nearly all laconically and, as would be expected, illiterately, their reasons why the paper was not delivered as requested. With the exception of five or six, who were actuated by cranky ideas, they did not want the engineer to be "wasting his time reading," as that would probably detain him from work—and he was hired to work, not read. These workmen knew enough already, and the more engineers "knew" the lazier and more inefficient they became. This is the epitome of the consensus of their opinion on this subject.

We do not believe that such men make much of a success by their own efforts. Such bad judgment exercised in every department of a business would certainly wreck it sooner or later. This ilk of men oppose progress at every step. The old ways are good enough for them. It is such obtuseness that made the middle ages a dark, desert waste of time in human experience.

But we are happy to say the men referred to above are the exception and not the rule. From a greatly larger number came subscriptions from the office for the engineer, with words of encouragement and appreciation.

The manufacturer is getting better educated every year and the more he learns about steam plants and good business methods, the better power appliances and engine and boiler room help he wants. We predict that the time is not far distant when every concern burning coal for generating steam will own an indicator, and will pay their engineer a price that should procure a competent man, capable of handling the plant and using the indicator.

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ABOUT PAPER.

We were disappointed in the paper ordered when we installed our new office and equipment, and would not have used a sheet of it had it been possible to procure a sufficient quantity of a stisfactory quality to last us until a new lot could be manufactured. The amount we require for one edition is such that no paper company could supply from their stock the necessary number of reams. This compelled us to use the unsatisfactory paper for the November first and fifteenth issues.

When the carload of defective stock was delivered at our press rooms we at once examined it and discovered its faults. The manufacturers were informed of the condition of the stock. In their reply they say: "Printed copy of your publication received. We must say that this sheet of paper is very tender, and we can not understand why it is, as this is the first complaint on this account. We are willing to make you a new lot, as we are very desirous of having any paper we ship you satisfactory in every way. We will hasten to make the new lot at once."

It requires nearly a month to make such an order and get it here, but the December 1st issue will be printed on a better stock and after that the paper will be uniform and of the best quality and finish.

We take this space for explanation because this company has always bought first-class paper, and we wish to assure our readers that we accept nothing else. Perhaps it is not generally known, except to publishers, that the quarantine against rags from Europe sent all book paper up like the thermometer on a hot day, and as it still continues there is no immediate prospect of a lower price. Besides this, a good quality of paper is hard to get at any price now.

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THEIR PIPES FROZEN.

We understand that a considerable number of steam plants recently installed in Ohio were so damaged by the cold weather of latter November that they had to be shut down. They were not finished, the contractors or concerns owning them allowing the work to drag on, thinking that "to-morrow," "latter part of the week" or "the first of next week" would do for finishing the job. December weather is not always experienced in November, but it is just as likely to come as any other kind, and it is wise to be prepared for it. The plants caught unprepared, of which we have personal knowledge, remained idle several days—some can not start for two or three weeks. The loss will more than overbalance the entire cost of covering the pipes with mineral wool, asbestos or other material to protect them from the cold.

The best thing to do is to finish the tributaries and subordinate portions of a plant complete before leaving the job. The best builders will put things in shape to withstand the severest cold, even if installing in June. We hope that many were not served as were those to whom we refer, but it is a lesson they will not forget. But there are people with whom only the very dearest teacher—personal experience—is effective in inculcating the truth.

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EQUIPMENT FOR FIRE DEPARTMENTS.

The city of Cleveland is likely to have in the near future, the best fire department in any city of its size in the country. The business men have agitated the question of issuing bonds to the amount of $200,000, with which to re-equip the city with proper fire machinery.

If this is done a new fire boat will be built. The efficiency of fire boats has been thoroughly demonstrated in many other cities besides Cleveland. They have come to stay. It may be said, however, that the design of boats for fire service and of their engines and pumps is still faulty. There is a good field in fire-boat construction for some naval architect acquainted with the needs and past defects of such craft to build himself a reputation and make money. Fire engines, too, are now just about what they were twenty years ago. While there has been remarkable progress in other departments of engine and boiler construction, this has remained stationary. Some live builder should take the hint and enter the field with an improved fire engine on wheels.

QUESTIONS & ANSWERS

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(463.) John Luhring, Arlington, Minn., writes: "Please answer in your next number, what nominal horse power my engine is. The same is 14"x24", valve cuts off at 8", 100 revolution per minute, with 80 pounds boiler pressure. 2. What horse power is a boiler, 50" in diameter, 14 feet long, with 62 three inch tubes?. A.—1. The indicated horse power is about 90. 2. 15 square feet heating surface are generally allowed for a horse power. You can figure the square feet easily.

(464.) Albert Orton, Lansing, Mich., writes: "Please let me know how I can put a blue color on a gun barrel." A.—Give it a coat of nitric acid, spread on liberally, and when it has corroded the barrel a film of oxide will cover the iron. Then the barrel should be cleaned, oiled and burnished. There is another and simpler way, that of heating the barrel in powdered charcoal over a fire. This does not always work satisfactorily, but is performed readily.

(465.) Victor Ferriott asked, in the November 1st issue, question 460, "How to cool off a hot box without using water, or patent oils, or without stopping the engine." Mr. Volney W. Mason, the well-known manufacturer of patent friction pulleys, of Providence, R. I., noticing Mr. Ferriott's question, writes us as follows: "I have often used a simple remedy, to introduce fine table salt into the hot bearing with the oil. This I have found to cool off a bearing, and it is so simple that it should be generally known, being of greater efficiency than any other plan with which I am acquainted."

(466.) Reader, Montpelier, Vt., writes: "I would like to know a good way to harden a chisel with which to cut hardened iron. I have tried various methods, but none of them give a degree of hardness suitable." A.—We have lately seen a job done with a chisel hardened by heating to a low cherry red, and plunging in saturated solution of chloride of zinc. It worked very satisfactorily, and we think you would do well to try it.

(467.) R. B. Norwood, Minneapolis, Minn., writes: "I have a compound non-condensing engine and wish to know how to figure its water consumption. Please let me know what information I must give you in order to tell me." A.—There are various methods of figuring water consumption. A simple one is to divide the constant 200 by the square root of the initial pressure. Ninety per cent. of the product will be the water consumption per horse power per hour, that is if the engine cuts off at $\frac{1}{4}$ stroke, as is the usual practice in such machines. If your initial pressure is 80 pounds then $\frac{200}{8.9442}=22.36$. Take off 10 per cent. of this and the water consumption is shown to be 20.13. For a single non-condensing engine use the same method, but 10 per cent. does not have to be deducted, the product of the constant 200 divided by the square root of the initial pressure being the water consumption per horse power per hour.

(468.) C. McD—— Co., writes: "We ask to be informed how to find square root. We cannot figure it, but have heard there is a shorter cut than the old rule in arithmetics." A.—You should buy some engineering book which has tables of squares and cubes and square and cube roots. It is easy to extract square root, but if you wish to arrive at it by a "shorter cut," we can suggest no other way than to find that number which, multiplied by itself, will produce the number the square root of which you want. Where the square root has no fractions this is simple, but to arrive at the exact fractional parts by multiplication is tidious. Take for example 2,400. By multiplying we find that 49 is the square root of 2401, and we see that it must be a little less than 49, but 48.90 produces but 2,391.21, and we have to try again. To get the correct decimals, requires a large amount of figuring, and not till a large sheet of paper has been covered is the result reached, 48.989, and this gives .023 too much.

(469.) J. B—— Co., W. Va., write: "We have trouble with our boiler forming scale so thick and filling up with mud so much that we can scarcely run a week without shutting down. We have to take our water from a creek that is not pure by a long way. What do you advise us to do with our boiler?" A.—Put in a first-class feed water heater and purifier.

☞Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

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THE following letter from George B. Grant, the well known writer and universally recognized authority on gear work, explains itself:

"I notice your remarks concerning the trade catalogue of Montgomery & Co.

"I publish a 'gear book' on the same plan exactly, charging 15 cents for it, and paying back the money on any business amounting to one dollar or more. Moreover I make it a small treatise on gears well worth the money for its own sake. I include an odontograph that cannot be bought of other parties for less than a dollar, and for which four dollars is sometimes asked. I give 15 cents worth several times over, and then pay back the 15 cents if the purchaser ever does any business. There is not a workman, apprentice, or draftsman who cannot get more than his money's worth of information out of 'Grant's Gear Book.' "

We can say that we believe every word of the above to be true, as we have seen the "gear book." It is worth much more than its costs. Mr. Grant's address is Lexington, Mass.

CHEAP ENGINEERS AND EXPENSIVE LAWYERS.

We frequently receive very decided expressions of opinion from those whose experience makes them the best judges against the old-fashioned, short-sighted, penny-wise and pound-foolish policy of employing the cheapest possible service in engaging professional engineers, while, when it comes to lawyers' fees and presidents' and managers' salaries, large sums are paid without hesitation. Any one who will take the trouble to find out how much time must be spent and what the amount and nature of the studies are to become a good engineer, and then compare this with that required to become a good lawyer, cannot fail to notice how much greater the former is. Moreover, in the engineering profession one must continue to study and keep abreast with the rapid progress made in engineering, while in the lawyers' profession the term "progress" hardly exists. Of the four professions, medical, theological, law and engineering, the latter is certainly the one in which one's reputation depends entirely on ability, that is, the one which requires the most conscientious work in order to gain and keep a good reputation. When an engineer is ignorant, and makes mistakes in building a bridge, machine or a mining plant, for instance, which thereby breaks down, there is no question where the fault lies and whose it was, and, what is worse, the lives of innocent victims are often at stake. Of all professional men, therefore, the engineer must work, study and practice in the most thorough and conscientious manner. He should, therefore, be selected with the greatest possible care, and receive the most liberal remuneration. The man who will take the greatest care in engaging a physician, regardless of cost, will go to his factory and engage cheap and incompetent professional engineers, and practically intrust the success of his manufactured products or constructions to their care, and then wonder why other manufacturers who pay for able talent are more successful. Some companies pride themselves, and with right, on the professional engineering talent which they employ and can retain by paying properly for it, but there still appears to be many who stick to the short-sighted policy of under-paying the one in whom the success of their products, to a great extent, lies.—[The Electrical World.

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Loss of Heat From Boiler Scale.

It has been held by many that $\frac{1}{8}$" scale in a boiler causes a loss in fuel of 28 per cent. It will be interesting to read what E. M. Herr, Superintendent of the Grant Locomotive Works, says in the Railway Master Mechanic: "In some recent tests made on a prominent Western road," he says, "the average temperature in the smoke-box of two locomotives was measured under as nearly similar conditions of operation as possible, the only difference being that the boiler of one engine was clean and free from scale, while that of the other so badly scaled as to necessitate stopping it for removal of flues and the cleaning of the boiler. The pyrometer averaged but 25° higher in the dirty than in the clean boiler with an average temperature of about 650°. This test is corroborated by similar tests on another road coming under my personal observation. A comparison of the fuel record of engines from each of whose boilers as much as 4,000 pounds of scale and mud was removed, also discloses no such great loss in fuel economy as this paper would indicate, but, on the contrary, shows no more than 4 or 5 per cent. loss which the pyrometer tests give. These boilers were covered with a combined sulphate and carbonate of lime scale, averaging certainly upward of $\frac{1}{8}$" in thickness.

"The bad effect of scale upon the life of boiler sheets and flues is unquestionable, and rather under than overstated in the paper. That a large saving in boiler repairs and all the attendant expense and loss of revenue from unserviceableness of the engine can be made by keeping the boilers free from scale has often been shown, and it is here, rather than in an excessive gain in the fuel record, that the economy and advantage of clean locomotive boilers is to be looked for."

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The Long Distance Telephone.

The communication by speech between New York and Chicago by means of the long distance telephone is one of the triumphs of science. We can scarcely realize that this has been accomplished. And yet, when conversation was carried on over a wire a distance of a mile, scientists foresaw that the telegraph would in time be outdone and that intercourse would be carried on, in the future not distant, in the natural and easy way—by speech—everywhere.

The next thing will be the laying of a trans-Atlantic telephone line, and who shall say that before another four years roll around the President of the United States will not be able to converse with the President of France, the Emperor of Germany and Queen or King of Great Britain?

The telegraph was nearly as great a discovery as the force exerted by steam in striving to reach the atmosphere. The telephone was equally notable and useful. It enhances civilization and disperses the dogmas and ignorance that once held the masses in subjection to oppressors and religious fakirs.

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IN rigging up a U-shaped draft gauge we have found some engineers who read the indication from the level the water was at when the gauge was not connected. This would show them the distance the water is raised in one glass of the gauge, but it is not an index of the power of the chimney draft, for this draft is sustaining a column of water a height equal to the difference between the heights of the water in each gauge. The difference between these two water levels in each glass, when the gauge is connected, is the measure of the power of the chimney draft.

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WITH the December 1st number we believe that we will be practically caught up with our issues and will be able thereafter to get out the paper exactly on time.

PRACTICAL LETTERS

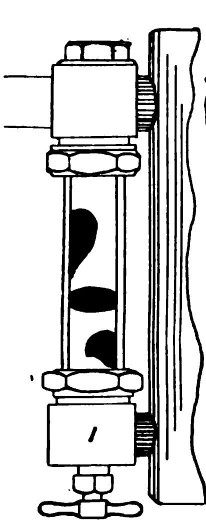
How to Remedy the Sticking of Oil in Glasses.

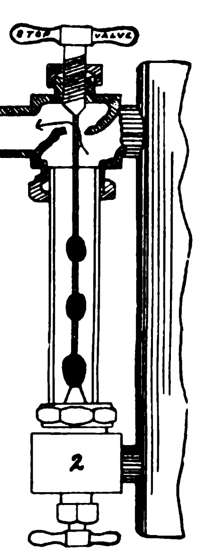
EDITOR SCIENTIFIC MACHINIST:

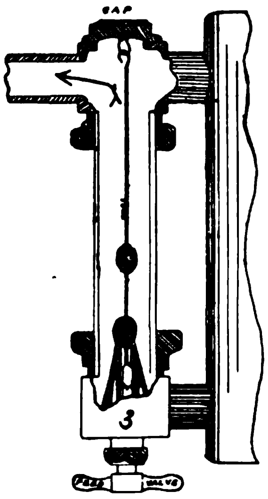
Since sight feed lubricators have come, and heavy cylinder oils are being used, there is often experienced a good deal of trouble from the cylinder oils sticking to the sight feed glasses in the lubricators. I have made drawings to show how this trouble can be stopped so that engineers can take advantage of it.

Fig. 1 shows the glass where the drops of oil are too large for the tube, or where the drops lop over against the glass and stick to it, making it impossible to tell how oil is feeding, and where the lubricator has a long glass tube this is worse than with the short glasses.

Where drops are too large for the glass and the glass is short, I close in the top of feed tube like Fig. 5, which makes the drops smaller and where the drop lops over against the glass around feed tube, I countersink the inside of the tube as in Fig. 4, which will start the drop up straight and prevent it from lopping over.







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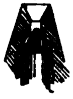

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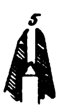

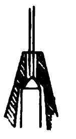

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But where it can be done in short glass lubricators I think a piece of wire soldered into the end of the feed valve as in Fig. 6 is the best, as the oil will follow it up and keep away from the glass. This wire should extend to top of glass tube or nearly so.

Fig. 2 shows the way I fix the long glass tube lubricators where there is a stop valve over the glass. All there is to do here is to solder the wire in the end of the stop valve as shown, letting the wire extend down nearly to the feed tube when oil will follow up the wire, keeping away from the glass. This wire can be soldered into the feed valve, when the feed valve is at bottom of glass as in Fig. 3, and where it is soldered in the feed valve as in this way it should not be connected to the cap.

Where lubricators have a cap over the sight feed glass, the wire can be fixed as shown in Fig. 3, letting the wire hang down into the feed tube, when oil will follow up the wire and not touch the glass.

By putting this wire in lubricators and filling the sight feed glasses with kerosine oil or glycerine, engineers will have no trouble from oil sticking to glasses. Fill lubricator before it gets entirely empty, as the last drops of oil in the lubricator are thrown in a scattered state against sides of glass, causing them to stick, and then the drops adhere to the glass causing trouble.

I think that from this explanation and with the aid of the drawings, engineers can fix their lubricators more readily and save all the trouble from oil sticking to the glasses.

J. A. MORGAN.

* * *

Was There an Error?—A Conundrum to Engineers.

EDITOR SCIENTIFIC MACHINIST:

In looking over the issue of Sept. 1st, on first page, I find that Canada has 75,768 industrial establishments, with 367,865 employes. Now that looks strange to me, as I find that it only leaves 4.85 in each establishment. I think there is a mistake somewhere.

I would like to ask a question to engineers—not the higher grade. The question is: suppose your engine is correct in every particular, apparently, crank and wrist pin keyed properly, shoes on crosshead right, pillow bearings right, engine in line, valves set right, dry steam, load steady, rings set right, follower bolts tight, and yet there is a knock. What's the trouble? This was my case, but I soon found out.

GEO. S. RAMSEY.

[The editor suggests that Mr. Ramsey write a letter explaining what the trouble was, and how he overcame it.]

Feeding the Furnace.

EDITOR SCIENTIFIC MACHINIST:

I see a good deal about the comparative efficiency of mechanical stoking and hand firing, and would like to give my views. The mechanical stoker is undoubtedly a great improvement and an economical method of firing a furnace. There is no engineer who would not prefer to have one. But the large majority can not get them. In the country they are very few. On this account it is well to know how to put coal into a furnace with a shovel. While a mechanical stoker is better than a poor fireman, I think a good fireman beats the machine. I would like to have every engineer in the country see how my fireman shovels in coal—see his scientific "twist." It is the most skillful I have ever observed. A great deal depends on the "twist" as well as on the evenness of firing.

C. B. HARTNELL.

UTILIZATION OF EXHAUST STEAM FOR HEATING PURPOSES.

BY EDWIN C. SHAW, M. E.

It goes without saying that the first consideration in the minds of those engaged in dispensing electric light is the economy in the production of power. The peculiar demands of electric lighting and the large monetary investment entailed thereby, call for the closest business management combined with the most progressive engineering.

No. 1 station of the Thompson-Houston Electric Light and Power Company of Buffalo is located in the heart of the city surrounded on all sides by a good market for the sale of steam heat and the management early adopted the plan of using their boiler plant for making steam by which to heat the surrounding buildings during the day when their own steam consumption was comparatively small. An experience, however, extending over some years, has not proven the economy ef heating exclusively with live steam from a central station doing a general lighting business.

Theoretically, steam can be produced at a central station and distributed therefrom for heating purposes at a less cost than the same amount of steam can be produced in isolated heating boilers in the several buildings to be heated. As a matter of fact, however, the extra attendance which the service involves, the excessive losses through radiation and leaks and in cases where the piping from the central station has not been laid out with a view of the most complete interchangeability, the inconvenience in the matter of cleaning and making repairs on the boilers and mains, and when a station, which is generally the case, is running on a small power reserve, the forcing of the boilers which this service at times will entail—all unite to render the economy of distributing heat from an electric light station a grave question. The use of exhaust steam, however, solves the question. It is a by-product and the income realized from its sale represents nearly clear gain.

Each horse power of boilers will heat 10,000 cubic feet of space from exhaust worth approximately $30, when in continuous use during the season of heating, at a cost of simply the interest on the investment in the street main, while the efficiency of exhaust steam is fully as high as live steam for heating purposes, there being practically no difference in the total temperature of the sensible and latent heat. The only plausible objection to the use of exhaust steam distribution from a central station for heating purposes is the question of back pressure upon the engine and this has been most satisfactorily solved by this company in the adoption of the Barnard Vacuum system.

When the boiler plant is favorably located for the work I have no hesitancy in saying that a central station whose service extends over the 24 hours of the day will find that the revenue from the exhaust steam heating compensates for the disadvantages that can be charged to a high pressure station. It is simply a question of gain by the use of exhaust in condensing as against the revenue to be derived from the sale of exhaust steam for heating purposes. It is but a matter of a moment's calculation. The best engine duty will not show a consumption of 20 per cent. of heat units in steam used, that is from 75 per cent. to 80 per cent. of total heat units pass off in exhaust steam, which, if sold for heating surrounding buildings, will bring in a revenue of from $20 to $30 per year per horse power exhaust, while if it is used for condensing fully 75 per cent. of its heat units will pass off in the water from the condenser affording as a revenue an increase in engine efficiency of from 25 per cent. to 30 per cent.

Tne principle of the Barnard apparatus used by this station is simply the application of a surface condenser through which the feed water passes on its way through the feed water heaters to the boilers and in ejector connected to the condenser to relieve it of the air liberated from the condensed vapor. The condenser is also connected to a main air pipe, which in turn is connected by branches to the air cocks of the several radiators in the buildings to be heated.

The action is simple. Steam is turned on from the main exhaust from the station, after it leaves the heaters, into the exhaust pipe to the buildings to be heated. The ejector on the condenser is then started, creating a vacuum in all the radiators in the building to be heated. The exhaust steam is thereby drawn through the main pipes into the radiators. As fast as the condensation takes place, the condenser removes the air and vapor from the radiators and new steam follows, thus affording as complete circulation as if steam is forced through by the pressure. All the return drips are brought back by gravity from those localities whose elevation renders the return practicable. This water is returned to a main receiving tank at high temperature, is mingled with the main feed, and is pumped through the heaters to the boilers.

In some cases it may be necessary to balance the system by regulating the "pull" upon the radiators at the air valves in order to avoid short circuits and consequently unequal distribution of steam.

The method used in laying the street main is effective and still inexpensive. The main steam pipes, returns and air pipe, are laid inside large vitrified tile, being supported at intervals of fifteen feet by cast iron spiders, placed at the joints of the tile and perforated around the edge so as to allow any moisture that may gather within this air space inside of the tile to flow back to the station. The provision for expansion and contraction are made entirely in the formation of the runs, long bend being given to the run at both ends of the service. With five inches of vacuum on the condenser the steam has been, in the coldest weather this winter, circulated through the coils of the system, and the attention required by this system has been practically nil.

It may be of interest to know that there are no back pressure valves on the system and that the exhaust from the engine is perfectly free.

A great deal more might be added to this subject, but enough has been said to give clear ideas of the general principles.—[Master Steam Fitter.

RAILROAD MOTIVE POWER.—IV.

Of late years it would seem that railroad companies think of little else than forming pools and cutting rates. When not engaged in one of these delectable pastimes, they are almost certain to be in the other. At any rate, there seems to be a continuous warfare, an irrepressible conflict. Now, I wonder if it has ever occurred to those who direct the destinies of railroads, that there is still another pool of much greater importance than any they have so far worked up, viz, a locomotive improvement pool.

I presume to say that if all the money that has been squandered by railroad companies, during the last twenty years, in experimenting independently of each other, were put into a pool, such as I have suggested, and placed at the disposal of the American Master Mechanics' Association, the locomotive of today would be a marvel of simplicity in construction, and of economy and durability in service. It is but justice to say that the Master Mechanics' Association has labored long and assiduously to give railroad companies a better locomotive for the same figures, and if their efforts have not been crowned with success, it is because railroad companies have afforded no encouragement to the association, and have given it at best but a negative support.

What the association really needs to carry out its primary object, is a carte-blanche and ample funds to back it up. Is the plan I have suggested a feasible one? I think it is. Will railroad corporations adopt it? I fear they will not. Why? Because they see no immediate cash returns in it. There is no passenger or freight pool tariff mixed up with this scheme, consequently no opportunity for cutting under. What a splendid opportunity the locomotive improvement pool could afford for testing the qualities of hollow side rods, and the merits of balanced slide valves, improved fire boxes, smoke preventers, and patented devices of various kinds, with the result of retaining and adopting the really meritorious contrivances, and relegating the impracticable and worthless to the shades of oblivion. I have in mind the furore that was created some years ago, over copper fire-boxes and water tables. I mention copper fire-boxes because in the case of an Ohio road the fire-box was born of a water table, if I may use the expression. Well, the Ohio road tried the copper fire-box and water table, $8,000 worth inside of six months, and at the end of that time sent the entire outfit to the brass foundry for scrap. This was a pretty clear case of tried and found wanting. About the same time a neighboring road tried a new-fangled electrical device for preventing the forming of scale in steam boilers. However well the contrivance might have worked elsewhere, it proved anything but a howling success in a locomotive boiler. The result was that after a three months' trial the complete outfit was sent to the scrap heap, entailing a loss to the company of some $2,500, minus the value of the scrap. I once knew a supremely ignorant and conceited master mechanic, who spent all his own spare cash and about $2,000 of the company's money in the futile and foolish attempt to consume the products of combustion, by arresting them in the smoke arch and then returning them to the fire-box. In persuit of his object he so completely filled up all the available space in the smoke arch with elaborate and unscientifically arranged spark arresters, conductors, etc., as to almost completely choke the draft. Yet, this M. M. was so unreasonable as to threaten to discharge an engineer—who was so unfortunate as to have this miserable contrivance put upon his engine—because he punched a number of large holes in his stack netting, with a view, if possible, of getting a better draft. Perhaps I do this M. M. an injustice in making the latter statement unqualifiedly, as he may have objected, not so much to the holes, as to the crude tool employed in making them, namely, a coal pick. However, as time wore on the company realized that it would soon have to do one thing or another; either doublehead all trains or else get a new M. M. It decided upon the latter course, and the result was that this elaborate array of spark arresters, conductors, etc., was incontinently consigned to the scrap heap.

Some few years ago we had a regular smoke consuming craze. Any number of devices, good, bad and indifferent, were put upon the market. Some engineers ridicule the idea that smoke can be consumed, while others again stoutly maintain it can. When doctors disagree, who shall decide? In reading, a "puff" of one of those patent smoke consumers, from the pen of a United States Supervising Inspector of steamboats, I noticed the following nonsensical statement, that is to say; that using this particular device, "would prevent the formation of scale in the boiler on account of the rapid evaporation of the water." If this were true the patentee would have a better thing than a bonanza silver mine. While upon the question of fuel combustion in boiler furnaces it may not be amiss to quote from a paper read by an eminent engineer before the Master Mechanics' association. This gentleman having thoroughly investigated the subject of better combustion, said: "It is generally felt that combustion in locomotives is not as complete as it might and ought to be. We shall never be able to attain to complete combustion in a locomotive unless we know exactly the relation between the steam worked off, the coal consumed, and the air led into the luminous gases by the action of the exhaust. Liebig tells us that 11.3 pounds of air will consume one pound of coal, chemically complete, or without producing a particle of smoke. This then, would be the combustion we ought keep in view. He further tells us that one pound of coal, thus completely consumed, will produce an evaporative efficiency of from 10,700 to 12,700 degrees, according to quality. The time of contact between air and luminous gases, in its passage through the fuel, is said to be .816 of a second, and the bulk of fuel on grate is to be always in proportion to the quantity consumed per second. If we should happen to have a furnace when the influx of the air is always in just proportion to the fuel needed, and a fireman who always has a bulk of fuel on the grate, proportional to the consumption of fuel per second, it is evident that combustion in our ideal furnace would be perfect, and with a temperature of 4,000 degrees F. we could not have any gases escape without igniting; consequently we would have no smoke."

D.

(To be continued.)

THE STEAM ENGINE INDICATOR.

BY MILLARD F. BURGESS.

Steam engine indicators are not as well known in the South as they should be. Probably 10 per cent. of engineers understand them and 5 per cent. use them. If they were used more and employers would recognize their worth, there would be less complaining about expensive fuel. As soon as an employer has dealings with indicators he has his plant tested for waste of fuel, and begins to have the scales fall off his eyes. If he has a large plant, say of 200 H. P., he wants to secure one, but the first cost is too much for him. So he goes along, not knowing what he is doing, only guessing at it, and finding fault with the engineer if he thinks the fuel bill too much. If he has a good engineer he soon loses heart and quits, but if the engineer has an indicator and uses it, he can tell his employer or superintendent just what he is doing, where the fuel goes and how much water his engine is using.

Then again, as soon as the engineer takes diagrams, he begins to compare notes with other engineers; they exchange diagrams, each trying to do better than the other. Too often the employer makes a kick about it. They make a mistake every time. I know of three instances where the engineer has secured indicators by the employer purchasing them, and the engineer paying his employer so much a week for them. One plant paid for the indicator in six weeks in the saving of fuel, and yet there are some employers who have no use for indicator engineers, so-called. If his neighbor has a man that understands the indicator and works by it, his neighbor's plant will improve and help his profits, while his own plant goes down and his profits grow less. Then again, some of the engineers are so narrow in their views that if you say a word to them about the indicator they reply "it is only a Yankee trick," of no use to them; their plant runs well enough without it. Generally they are the no-account men, with no desire to improve, and are stumbling blocks to good engineers; stolid men, strongly opposed to license law for the engineer.

If employers would stop and figure the difference between an engineer receiving $9 per week, his engine consuming 5 to 6 pounds of coal per H. P., and an indicator engineer receiving $18 per week, his engine consuming 2½ to 3 pounds of coal per H. P. per hour, there would be less complaining about poor engineers.

Some employers will say: "Well, look at the difference in wages." Now, look at the difference in fuel bill. A, an engineer that does not use the indicator, runs a 300 H. P. engine 10 hours per day, consumes 66 tons of coal, or 1,491.84 pounds per hour, which is equal to 4.9 pounds per H. P. per hour. B, an engineer that uses the indicator, consumes 45 tons, or 1,080 pounds per hour, which is equal to 326 pounds per H. P. per hour, both engines doing the same work. At the end of the week it makes a difference of nearly 13 tons of coal; and with coal at $2.75 per ton, a saving of $35.75. This is taken from actual practice, and came from simply changing the valves or setting them by the indicator, also keeping the plant in trim.—[Read before Charleston Engineers' Association.

The First German Paper-maker.

"In the name of Christ, amen. Anno Domini 1390, I, Ulman Stromer, started at making paper on St. John's day at the Solstice, and began to set up a wheel in the Gleissmuhle, and Clos Obsser was the first who came to work."

So said Ulman Stromer, undoubtedly the first German paper-maker, in his notes which are still preserved. Five hundred years have passed since then, and the art of paper-making can look back on as long a period of earnest effort and profitable work. When Ulman Stromer so long ago established paper-making in Germany he had no foresight of the important position paper was destined to assume in the civilization of man. In book-printing, and outside of it, it is the most efficient agent in the advancement of the race, and has become a supreme necessity. It is the foundation of the book and newspaper arts, the indispensable aid of science and instruction, as well as of commercial and social intercourse. In short, it so governs our whole age that hardly anything could be thought of without paper in its present shape.

It was different in Ulman Stromer's time. Paper was then a rare material, little used, and only to be found in the offices of the learned, of scribes, and of officers. The supply of Germany and of all northern Europe was brought from Italy and Spain, most of it from the factories of Fabriano in Italy, where paper-mills existed in the twelfth century, while a lively paper industry flourished in Spain, with its principal seat at San Felipe in Valencia, as early as 1150. The paper-making art was introducted into both of these lands by the Arabs, who learned it in Samarcand and spread it through Europe. It was introduced into Samarcand in 751 by Chinese prisoners from their country, where it had been carried on from extremely ancient times.—[EDUARD GROSSE, in The Popular Science Monthly for November.

THE Commercial Electric Co. of Indianapolis, a new company just started for the manufacture of dynamos and motors, have placed their contract for the equipment of their works, with The Lodge & Davis Machine Tool Co. of Cincinnati, for their improved lathes, planers, shapers, drill presses, milling machines, etc.

THE CONSTRUCTION OF RAILWAY MOTORS.

The constuction of railway motors is a line of mechanical work of recent origin. There is no machine that is subjected to the strain, wear and tear of a street railway motor, and competition is now so fierce that none can remain on the market unless it is thoroughly efficient.

The illustrations, or sketches, here presented, were taken in the shops of the Short Electric Railway Co., of Cleveland—one of the best equipped in the country. Through courtesy we are enabled to present them to our readers.

The preliminary work on the motor armature, the fundamental part of the machine, involves an interesting operation, which is illustrated in No. 1 of the accompanying sketches. The view shows the method of boring or trueing armature hubs. The casting is placed against the face plate, which is vertical and at right angles to the bed of the machine. It is fsstened and centered by hoop bolts, its position being such that the opening for the armature shaft is turned absolutely true.

The next step is to place the hub on the mandrel of a lathe on which the periphery is turned true; then to wind on the Norway sheet iron core with tissue paper, separating the successive layers, the last eight or ten layers of iron being of extra width, and then the core is ready for the four-spindle milling machine shown in the next sketch, No. 2.

This ingenious machine was designed especially for cutting out the slots in the armature core. An inspection of the machine shows that it has four horizontal shafts, each of which is belted independently to a countershaft, and each is connected to a vertical shaft by beveled gears. Attached to each of the latter are cutters all in the same horizontal plane. The core is mounted on a shaft passing through the center of the machine and is rigidly held. Special adjustments make it possible to mill cores of different sizes and to insure absolute accuracy in the slots both in width and in their relation one to another.

In the balcony can be watched an operation of special interest. Sketch No. 3 illustrates the winding of the armature for the new gearless motor. The armature is mounted on a temporary shaft resting on a stout wooden horse, so that it may be easily turned as the work progresses.

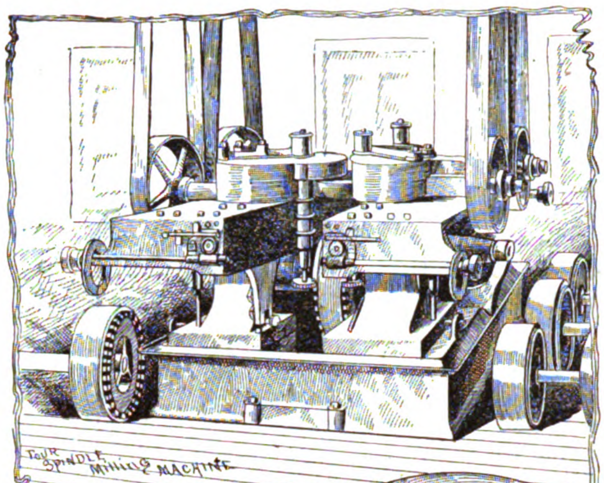
The next sketch (No. 4) graphically tells its own story of the mode in which S. R. G. motor frames are bored and faced by a horizontal boring machine. The holes in the casting are trued for the axle and armature shaft bearings.

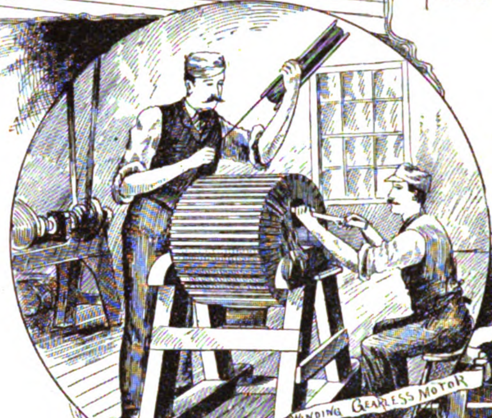
The holes in the motor frame through pass the bolts for holding the field magnets, must, of necessity, be accurately drilled. To perform this operation with rapidity and exactness, i. e., so that the direction of the sixteen holes may be in alignment, Mr. Hassen of the Short company has designed the gang drill shown in operation in sketch No. 5. Eight holes are simultaneously drilled in one side of the frame, and when the work is completed the casting is swung around on a pivot and the operation is repeated. The drills are all operated at one time by a set of gears contained in a wrought iron case.

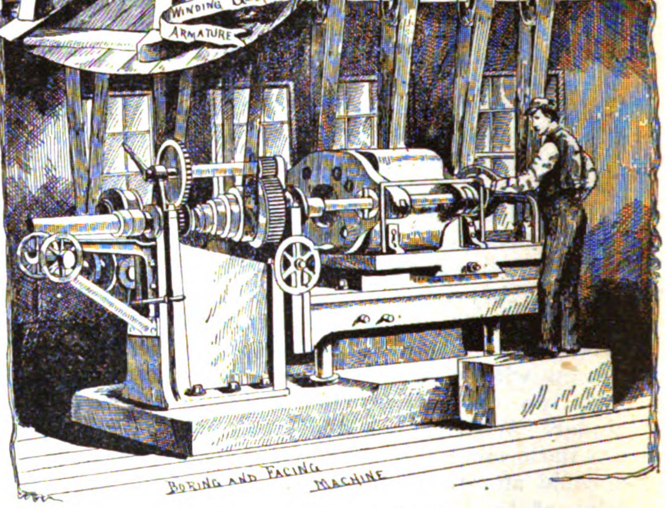
A short-cut expedient is illustrated in the manner of testing motors (sketch No. 6.) Two machines are inspected at the same time by running one as a motor and connecting it to a second machine which is operated as a generator. The sketch shows the means that are employed. Both motors are mounted on a substantial framework, and attached to each armature shaft is a temporary pulley with a belt connecting the two. A switch is at hand for turning on the current which may be varied at will, while the machines can be inspected under changing conditions. The load is carried by a bank of incandescent lamps which are found to constitute the best form of resistance.

In sketch No. 7 is represented a planer, facing the inside of a thirty-six inch generator frame, so that it may present an absolutely true surface for the mounting of the field coils.

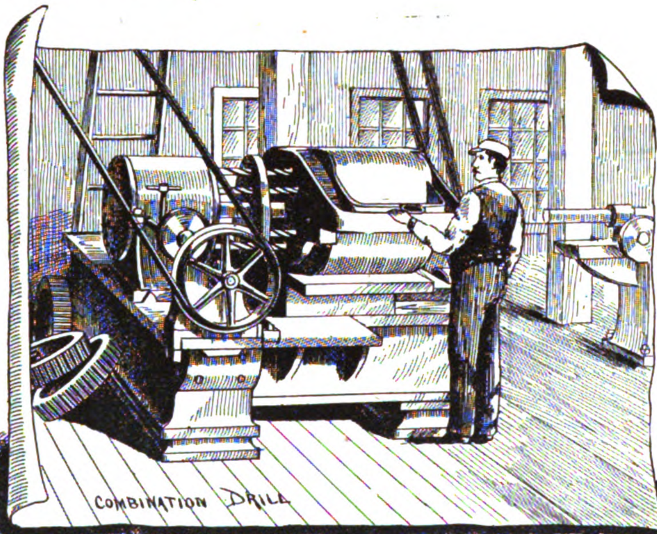
A special lathe (sketch No. 8) is available for facing the inside of the casting for the fifty-inch generator. The operation, as conducted, is interesting and somewhat unusual. The head stock is of the ordinary pattern, but it is so mounted that its inclined base may

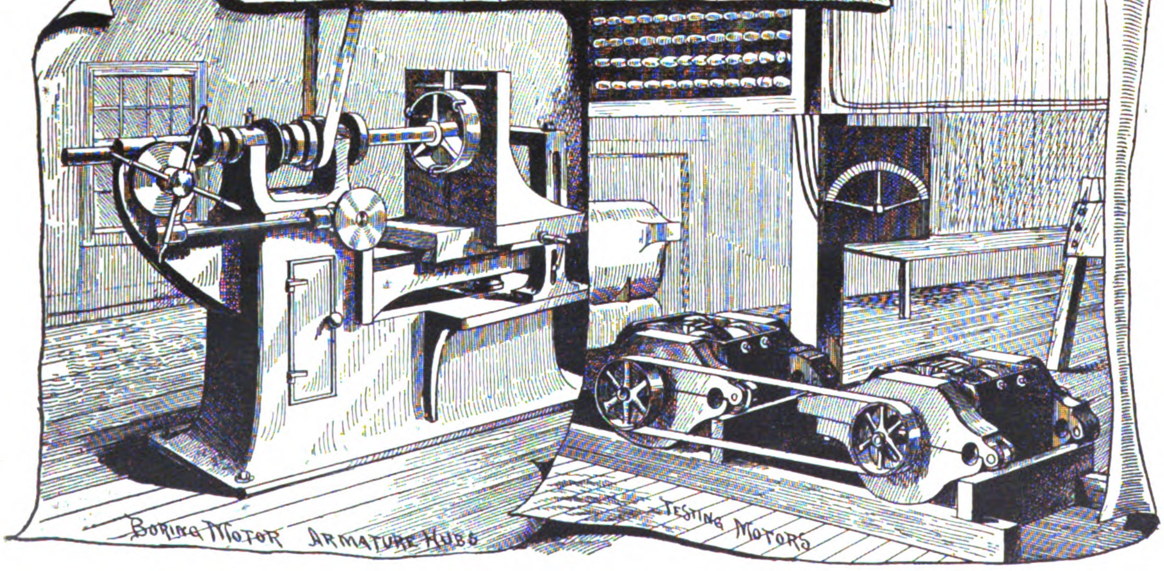






Figs. 2, 3 and 4.





Figs. 5 and 6.

travel on a corresponding inclined foundation. It can be raised or lowered by the adjusting screws at each end of the base, so that it may be accommodated to the different sizes of generators. A shaft passing through the generator or frame is mounted on the generator bearings, and is connected by a dog to the lathe. A tool holder is mounted on the shaft, and the feed is automatically governed by a novel device. Attached to the outer end of the feed screw is a head with four projecting arms. At each revolution of the shaft one of the arms strikes against a pin-on the frame, giving it a quarter turn.

There is no more intesting operation to be seen than that performed by the universal drilling machine (shown in sketch No. 9) boring a thirty-six inch generator frame for field magnet bolts. The hevier castings rest in front of the machine on T rails, which are leveled, and are shifted by jack screws, the smaller generator frames are placed, when drilled, in a pit at the base of the machine.

The double headed milling machine (sketch No. 10) is of novel design, and was built expressly for facing pole pieces. In this view four thirty-six inch magnet cores are shown clamped to the bed plate, but the machine is so designed that sixteen motor magnet cores may be substituted for the four larger castings. Two cutter heads face both ends of the cores at the same time. The feed is automatic, and the machine is one of the great labor savers in the plant.

When their sketches were taken, one of the operations to be seen was the winding of the 300 H. P. generator armature (sketch No. 11.)

There are many interesting methods and "kinks" in use in these shops of which we can not speak. On page 12 is illustrated the method of assembling.

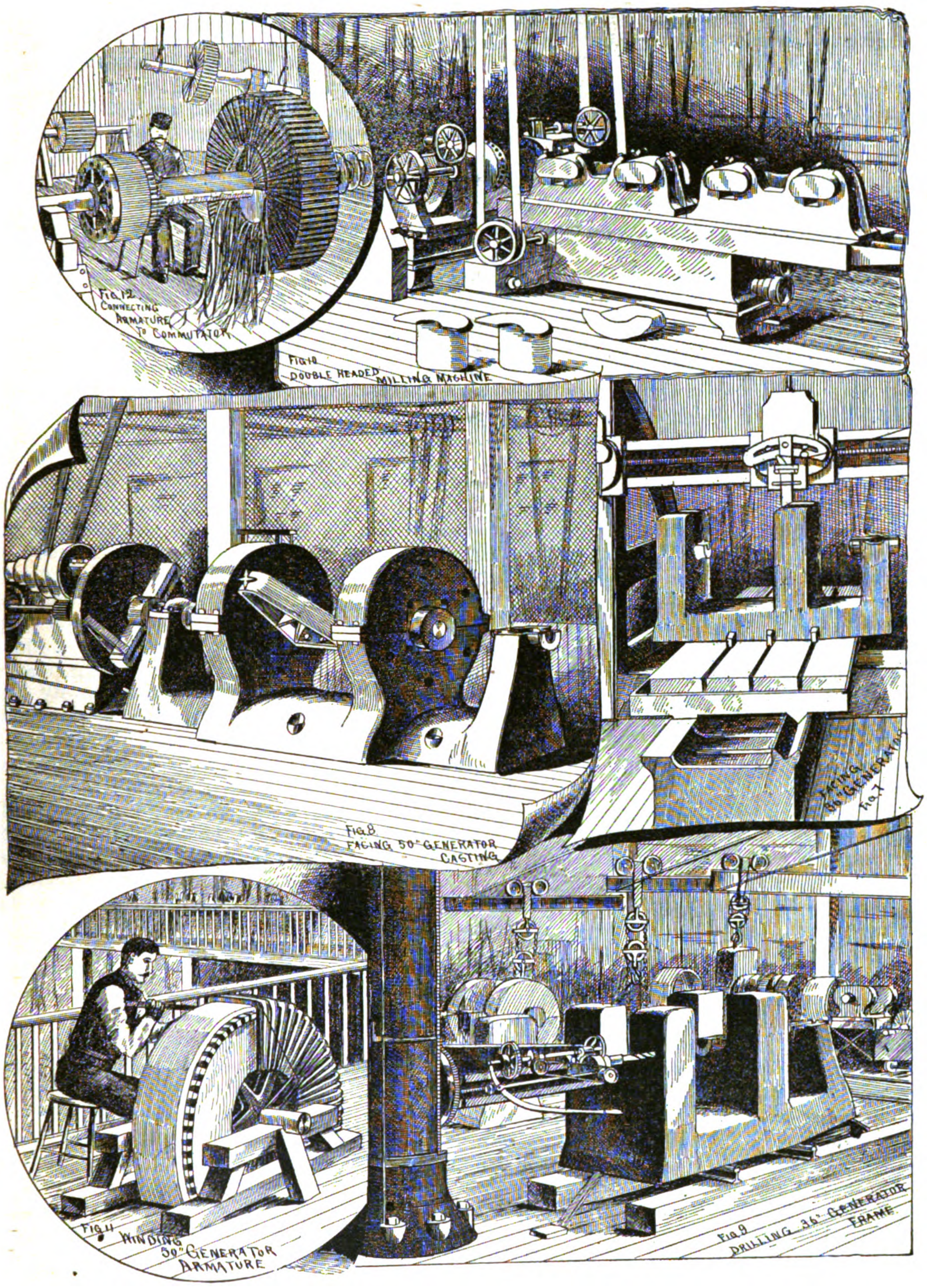


FIG.12
CONNECTING ARMATURE TO COMMUTATOR
FIG.10
DOUBLE HEADED MILLING MACHINE
FIG.8
FACING 50" GENERATOR CASTING
FACING 50" GENERATOR
FIG.7
FIG.11
WINDING 50" GENERATOR ARMATURE
FIG.9
DRILLING 36" GENERATOR FRAME

FIGS. 7 TO 12.

Books and Catalogues.

"COOPER ON BELTING — A treatise on the use of belting for the transmission of power, with numerous illustrations of approved and actual method of arranging main, driving and quarter twist belts and of belt fastenings. Examples and rules in great numbers for exhibiting and calculating the size and driving power of belts. Plain, particular and practical directions for the treatment, care and management of belts. Descriptions of many varieties of belting, together with chapters on transmission of power by ropes; by iron and wood frictional gearing; on the strength of belting leather and on the experimental investigations of Morin, Briggs and others. Third edition. By John H. Cooper, M. E. 1 vol., demy octavo, Duce cloth, $3.50."

This is the great text book on belting: As will be seen by the above, it embraces a large variety of information on the subject from an authoratative source. There is no department of mechanics on which the average manufacturer is so ignorant as on the science of belts and transmission of power by belts. Mr. Cooper's book is practical, can be understood by any one with an ordinary education and is just what is needed by superintendents, foremen, engineers and manufacturers. It is published by Edward Meeks, 1012 Walnut street, Philadelphia, Pa., who will send a further description to any address.

Methods by which Obelisks were Moved.

In the quarries at Syene is seen an unfinished obelisk, with traces of workmen's tools clearly seen on its surface.

This unfinished obelisk, says the Rev. J. King, in his "Cleopatra's Needle," shows the mode in which the ancients separated their immense monoliths from the native rock. In a sharply cut groove marking the boundary of the stone are holes evidently designed for wooden wedges. After these had been firmly driven into the holes, the groove was filled with water. The wedges gradually absorbing the water, swelled and cracked the granite throughout the length of the groove. The block, once detached from the rock, was pushed forward upon rollers made of the stems of palm trees, from the quarries to the edge of the Nile, where it was surrounded by a large timber raft.

It lay by the river side until the next inundation of the Nile, when the rising waters floated the raft and conveyed the obelisk down the stream to the city where it was to be set up. Thousands of willing hands pushed it up an inclined plane to the front of the temple where it was designed to stand. The pedestal had previously been placed in position, and a firm causeway of sand covered with planks led to the top of it. Then by means of rollers, levers, and ropes made of date palm, the obelisk was gradually hoisted into an upright position.

◆

IT is better to know less than so much that isn't so, is the remark of a sage philosopher, and so evidently thought a correspondent of the Machinist, who was present at a gathering of gentlemen in which the central figure was a lawyer who prided himself on his literary taste and conversational power. Touching on the wonderful strides of science and invention, he said: "Why, they now have governors which can be applied to the gas pipes in our houses, and which regulate the supply of the gas to suit the number of burners in use, and its action is identically the same in principle as that of the governors used on steam engines. There you know they have those two balls that hang by arms and revolve rapidly when the engine is in motion. Now they are used to regulate the pressure of steam, and are so arranged that when the pressure is just right the balls remain in one position, but when it gets too high it pushes a valve and thus raises the balls up, and in so doing expends its surplus energy. In this way the pressure is kept constant and the speed never varies." The listener said nothing and some one asked how it acted when the pressure became too low? "Oh, you see," he replied, "the balls then have an opposite effect by pressing down on the steam and increasing its power."

◆

UP to the year 1835 stoves in the United States were made almost exclusively in the blast furnaces, and directly from the ore, instead of being made in foundries from pig iron, as they now are, and they were consequently much hevier and ruder than now, and had loose and imperfect joints. Most of them were made in the furnaces of New Jersey and Pennsylvania, though a few were cast quite early in the furnaces at Coldspring, N. Y., and at Salibury and Canaan, Ct. From 1820 to 1835 a considerable business was done in stove-making in Rutland County, Vt.

THE ECONOMY OF COAL FUEL.

BY I. BOWE.

The methods of feeding coal for smoke burning may be condensed, I think, into four, and I will mention them in the order their merits entitle their recognition. The mechanical stoker or continuous feed, the common method, the retort system and the down draught. I place the mechanical stoker first for two reasons. Only a little fresh coal is at any one time on the fire; there is consequently but the minimum demand for air over the fire, and thus practically the draught through the fire is not at all interfered with. Next, as the door is but little used and no large body of fresh coal is on the fire at once, the fire being at all times nearly in an incandescent shape, would it not follow that less grate surface would be needed and less coal to do the same work?

The failure of the mechanical stokers we are familiar with to adapt themselves to all kinds of demands is no condemnation of the principle. I have faith that at some time, in some way, we shall yet have a perfected stoker that is practical for all work. I pass over temporarily the common method, and will simply say of the retort system that as a smoke preventer it has no superior, there being no such simple and valuable aid to air in getting good combustion as fire brick. The great point to be considered in connection with this system is, will results warrant the large first expense of putting in and the neeessary large subsequent expense of repairs? Can such a mass of fire brick be heated up and steam furnished as quickly and economically as when the flame comes directly in contact with the boiler?

During the past summer we have heard a good deal about the down draught system. The society for the prevention of smoke praises it; engineers almost to a unit condemn it. Forty years ago the English engineers wrestled with this idea and gave it up. It has now been revived for you to look at. As engineers these questions will naturally suggest themselves to you. Will the water-grates be durable, that is, will they burn out? Will they stand the strain of steam in tnat position? Will the joints remain water tight? Will they fill up with the lime and clay of our lake water, especially if the boiler is used only ten hours each day, or is allowed to remain idle for weeks at a time, as do many boilers? Would the volume of air passing down through a given bed of coals by the down draught system be as great as passing up through it by the common method? Can any kind of coal be advantageously used? Will the open fire doors materially increase the heat of the boiler room? Will the same number of firemen handle the fires as easily after putting in the furnace as before?

I have given you the points necessary in getting the truth in regard to this system, and if you are interested to know more about it just skirmish around among the help of any place where it is and you can get the above questions answered. As a smoke burner it is good. The time it makes smoke is not when fresh coal is thrown in, but when the bar is put in to lift the clinker so that the air will pass through. I see nothing about this furnace that warrants any unlimited endorsement more than a dozen others.

I take the common method last, because of it I have the most to say. It is the one we have the most to do with. Did it ever occur to you that it was a little strange that after a century of struggle genius had never developed a successful rival to the old shovel method? To the common setting by the common method there have been attached innumerable devices for preventing smoke. They nearly all follow one of three principles, or a combination of the three. Arch-work, ways of admitting air naturally, and the blast. Of arch-work I say as I said of the retort system, there is no such simple and valuable assistant to air in gaining good combustion as fire brick. There are many styles, but whichever one is selected should be with the idea of strength and durability. It has always seemed to me that the one on the bridge wall was the strongest. All work of this kind should be done judiciously, as we should never lose sight of the fact that the boiler is there to make steam as easily, quickly and cheaply as possible. Where the boilers are used for ten hours only, as is the case with the vast majority of places, the heating of any considerable amount of fire brick each morning would seem to be done at the cost of fuel. Some forms of arch-work undoubtedly obstruct the heat from the boilers more than others. When the demand for steam is fairly even and twenty-four hour fires are kept, a good deal more brick work may be judiciously added. To the arch there must be some way of admitting air. It must never be lost sight of that air goes up the chimney the easiest way, that all air above the fire takes away from draught through the fire. Here again good judgment and experience are worth everything. What might be judicious in one place might be rank foolishness in another.

It is just this kind of work by inexperienced hands that has led to such wholesale condemnation of smoke burners. Air hot, air cold, air at the front, air at the rear, air at the sides, air in the middle of the furnace, air in large chunks, air in small chunks, are some of the 10,000 methods of getting air. The English navy, which has undoubtedly spent dollars where we have spent cents in its investigations, claims that cold air is best unless a very small quantity is needed, as heating so expands it that a much larger volume is required, and that air is best admitted at the front of the fire, because the gases mix so slowly we are able to utilize more surely the oxygen; that air over the fire in openings greater than one-half inch in diameter is against economy. It is probable that holes of this size make the draught over the fire correspond more evenly to the draught through the fire.

No one of the appliances to burn smoke has been the subject of so much praise and condemnation as the jet. I confess I am no greater lover of the noise of hissing steam than you are, but I don't know how to avoid it. To the question, will a jet do damage to the boiler? I answer: Before the jet was used boilers were burned and bagged. The jet made a good scapegoat for all derelictions of duty that might cause injury. If the boiler is clean, free from all scale or mud, it is doubtful whether many fires could be made intense enough to do damage. From the time the boiler has been washed out until it is washed again of course mud is gathering, and for this reason I think it doubtful practice to put in jets and blow against the bridge wall. The most intense heat is at that point at any time, and the jet will certainly add to the temperature there. I consider the only safe way is to put arches on the bridge wall and distribute the heat through them. Equally bad is the practice of putting jets at opposite sides of the furnace and intensifying the heat at the center just under the boiler. So, too, the continuous use of the blast all day is bad, and all means of getting in air over the fire longer than is necessary to burn the smoke is, as a rule, a loss in fuel and power. I do not think the point well taken that the jet as ordinarily applied is liable to crystallize or oxydize the iron. Coal in burning makes steam. Every 100 pounds of coal make about 40 pounds of water (steam) as one of the products of combustion. If this form of steam does no damage to the boiler why should the jet, rightly applied?

There is no doubt in my mind that so long as we follow the ordinary methods of firing, to obtain good combustion, forcibly mingling the gases is a correct principle. The gases unite so slowly, but pass off so quickly that this would seem to be the only way to catch them. The use of the jet alone may be of some value in mingling the gases, but the correct use would seem to be as a syphon for air, or what we might call a cheap air pump. The jet should be used only as a supplement to all the natural means of smoke burning, because when we depend on the jet alone we are using a force that we have already paid money to make. There is no doubt that the jet is the most powerful single appliance there is in smoke burning, especially when the coal is rich, the work hard, or the draught defective. I believe in the jet only as the cheapest form of air pump. I have used compressed air in the place of the steam jet, and thus nearly doubled the capacity of a boiler and burned the smoke.

I recently made this statement in regard to the superior value of air as a blast to a local master mechanic of a railroad company. He informed me that he had been all through that question with an able mechanical engineer, and that I was a long way off. I challenged him to make a test and let me be present and run it. Of course they were too busy now to engage in such experiments. I forgave him because he is the inventor of a steam jet device. The idea that steam applied in this way makes water gas, and is of more value than pure air, is nonsense, and no one but a prejudiced party or one dense in ignorance would for a moment stand by such a statement. The oxygen of the water is already with its strongest affinity—hydrogen. Why should it leave it? The jet, like everything else connected with smoke appliances, can not be applied by any one who knows his work too well. Its efficiency and economy depend on its being done right.—[From a paper read before the Chicago Association N. A. S. E.

(To be continued.)

LECTURES BY THE OLD MAN.

Good morning, Mr. Oner, you seem to have quite a large batch of mail this morning. You have some that will interest me? Well, just hand it over, I like to be interested. Oh! this is from our breezy salesman, Mr. Selless. Undoubtedly from the small amount of business traceable to his missionary efforts in the business world, his name is in perfect accord with the eternal fitness of things. This is quite a long letter, ten pages. He advises that we paint our hullers a pea green with yellow striping and suggests that we call our 12x16 engines the "monarchs" and have the word put in large gold letters on the top side of the cylinders. Huh! and we ought to get one of those Leeds cylinder boring machines for our shops. He met a young man the other day in whom he became greatly interested and advises us to employ him, as he is one of the finest machinists in the state of Iowa, and has worked in eight of the largest establishments in that state, during the past year. Well, that is the poorest recommendation I ever heard of. Beyond a question, there is something radically wrong with a young man who has a record of only six weeks average time in each shop in a year. I don't want any of that material. Ah! he is telling his own woes, thirteen reasons why he has made no sales, the last one being that Mr. Bill Socia sent word out that he did not want to see him. I don't wonder at it. Mr. Oner, we will make a change in our sales department to the extent of a new representative on the road. You leave it to me? Thanks. Here boy, go in the shop and tell foreman Brailey that I want him in the office. Miss Stenograph, please put this letter through your machine and make it as emphatic as possible:

Mr. N. G. Selless, Hannibal, Mo..

Dear Sir:—Your ten-page epistle from Des Moines received and referred to me. Please listen. This firm hired you to go on the road and sell what we manufactured, not to write long essays advising us how to run our works and commenting on the vileness of the hotel accommodations you receive, nor to describe the beauties of the country in which you travel, nor the manners and habits of the people. The daily papers give such literature as we need in that line. As we are not needing a historian nor a long distance adviser you will please come home upon receipt of this and resign your position that we may send out a wide-awake salesman in your stead. Yours truly,

The Old Man.

'Morning Brailey. Yes, I sent for you. How would you like to go out on the road as commercial representative for us? You would like it. I thought as much. About the pay, your salary will remain the same as now until you prove yourself to be a success, then it will be raised accordingly. Good commercial missionary talent is scarce. I want you to remember that the best "drummer" is not the young man who talks loudest around the hotel corridor and is always looking for some one to play billiards and pool with. Neither do we want to receive any such essays from you as Mr. Selless writes. You will please read his effusion, also my reply thereto, which will make things clear to you. Remember, too, that a good salesman does not labor simply eight hours a day but is on hand to take advantage of each and every circumstance, day or night, that will enhance his employer's business. He is everybody's friend, and thoroughly appreciates the old saw, "molasses catches more flies than vinegar."

Mr. Oner will now take you in hand and, with the office force, will see that you learn all the little details relating to prices, discounts, side-cuts, commissions, etc., necessary to your success as a wide-awake hustling traveler. You are done with the shop from now on and I expect you to prove valuable and increase the firms dividends. I will now go in the shop and promote a man to fill your shoes.

Brailey traded watches seven times last month with the men and made money every time and when I made that "bluff" about buying his house, he painted its advantages so gaudy that I felt guilty in refusing to purchase. I guess he will do better on the road than in the shop. Every man should fill the niche in life that fits him best.

Ah! Good morning, Mr. Loftus. Mr. Brailey has been transferred to the sales department, you will take his place as foreman of this room and the men will be notified at noon. We require the most work possible at the least possible cost, not sacrificing good workmanship nor treating the men as inferior creations of the animal kingdom. I also hold you individually responsible for all errors and mistakes in your department, and not the men under you. Good day.

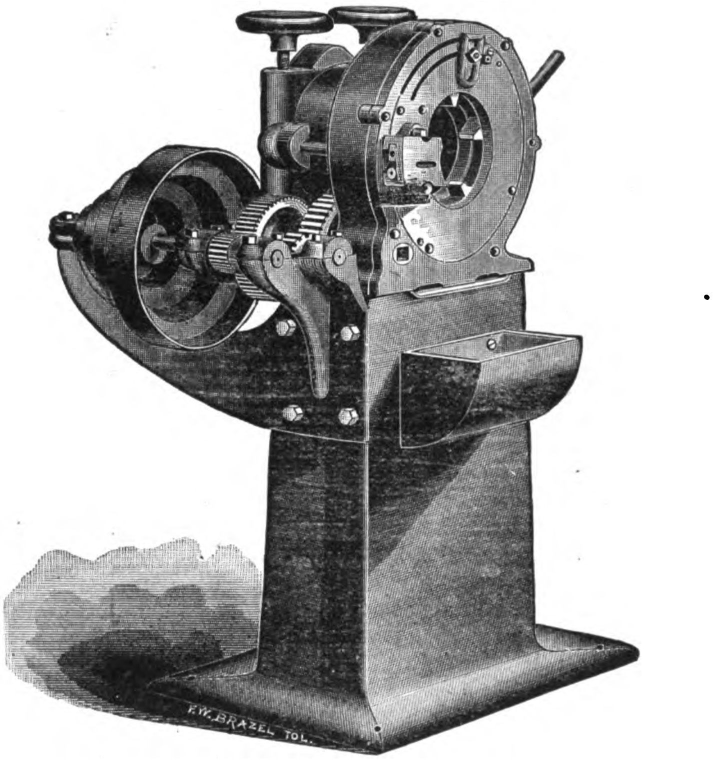
THE OLD MAN.

Laying of Flexible Water Pipes.

The Rotterdam authorities lately started the work of laying a tube in the bed of the River Maas, for the conveyance of water from the intake to the other side of the river, where the town has very much increased in population during the last few years. Up to this moment the water passes through cast iron pipes, carried under the big foot bridge connecting the banks of the river. These pipes were about three miles in length, and much too small in diameter to supply the factories and hydraulic cranes, which, with the other causes of water consumption, now require several thousand cubic meters a day. A new and larger pipe was determined upon, but to sink it in the river bed was not an easy job, for the river traffic is heavy at that point. It was impossible to make a wooden structure on which a long length of pipes could be bolted together, and then, when finished, sunk horizontally, as is usual in sinking gas and water tubes in the Belgian canals. Therefore a flexible tube was constructed, composed of short pieces connected with ball joints. Each pipe is 23.5 inches diameter and 0.4 inches thick, made of mild steel, and provided with steel flanges. The ball unions are cast iron, outside diameter 1,350 mm., or 4.5 feet; weight about 2,300 kilos, or 2.26 tons. To sink the tube two barges are fastened together, and between them is constructed a wooden inclined platform of about 120 feet in length, and one end of which hangs in the furrow made in the bottom of the river to receive the pipes. The tube is built up on that platform, one end of the pipe being made fast on the bank. Afterward the barges are pulled back so far that there is room enough on the platform to put on another length of pipe with its ball joint, and so on. The length of one pipe with its union is about 29.5 feet. The depth of the river is about 36 feet. The work has progressed rapidly, each day about 85 feet being laid. The whole length of the tube will be about 3,000 feet.

PORTABLE PIPE CUTTING AND THREADING MACHINE.

The accompanying engraving represents a portable hand and power pipe threading and cutting machine, covering the whole range of pipe fitter's use. Its economy of space, great power and range of work, convenience and perfection of operation, especially adapts it for the use of contractors and erectors of steam and power plants, large manufactories, etc.


F.W. BRAZEL TOL.

PORTABLE PIPE CUTTING AND THREADING MACHINE.

The die-head is completely journaled and protected from chips or dust.

The chasers are actuated by a convenient cam movement finely graduated with positive adjustable stop. They are readily exchanged for chasers of any size or make or pitch of thread either right or left, one set of chasers being used for several sizes of pipe, and are opened while in motion to remove the threaded pipe.

The cutting off knife, is always in position, is gauged to prevent overfeeding or plunging through uneven pipe, and is fed to its work by retaining the lever against rotation without care or effort of the operator.

The vise is nicely adjusted and self centering and feeds the pipe into the chasers by rack and pinion movement with hand wheel and lever.

Power is transferred from the cone pulley by gears as shown, which are covered to protect them from dust or accident. The gears are disengaged when the machine is to be used by hand or the machine can be taken from its base and operated by crank or ratchet lever according to the work to be performed.

The quality of these machines is of the highest grade and their proportions complete.

Full particulars pertaining to sizes and prices of their full line can be obtained from the manufacturers, the Wells Machine Works, Fostoria, O.

ENGINEERING NOTES.

The temperature of a chimney stack is often given as a measure of the economy of a boiler. If the temperature exceeds 400° it is taken as evidence that the heating surface has not been efficient or extended enough to take all the heat from the heated gases that it should. In taking this temperature, an engineer, writes, to inquire when it should be done, whether after firing immediately, or before firing, or whether it makes any difference when the temperature is taken. It certainly does make some difference when this temperature is taken. Immediately after firing, or very soon after, the temperature will be much higher in the up-take than it will be just before firing. This difference is often 150°,, and in considering boiler performance the time of taking the chimney temperature should be considered. We should think the best way would be to take a number of observations at equal stated times between the intervals of firing and average them for the final temperature of the report.

In crowded cities engines and boilers are often placed in crowded positions. In a very high and modern office building, being erected in Boston, the engine and boiler room is a space not fifteen feet square. The boiler will be an upright and the engine also vertical, with the dynamos on the same shaft as in marine construction. We predict that the eletectricity for this building will cost something.

In another place the boilers were placed out under the sidewalk, and after they were in place it was found the walk came almost to the top of the boiler so that the manhole cover could not be removed. This was before the regulations were passed that boilers should not be placed under the sidewalks. This boiler had to be removed, and the only way to get the new one into the still more limited space inside the building walls made it necessary to build it in place Space is valuable in those places

Machinery placed by a tenant in a building, and fastened to the floor by cleats or bolts in such a manner that it can be removed without injury to the building, is personal property and is not covered by a mortgage given on the land and building while the tenant is in possession, is a recent decision by the Supreme Court of Michigan.

Mr. Atkinson has been in Europe lately, and he stated that at one of the French towns, where a specialty of silk weaving is made, that the municipality has made arrangements for the installation of a motor to drive the hand looms in the houses of the town. Silk is woven best by hand, because the silk worm does not spin an even thread and the number of picks must be varied according to the size of the filling thread. This the hand weaver can do by changing the speed at which the looms is run. It is expected that the electric motor attached to each of the looms will also be capable of being given a variable speed exactly as the hand weaver now gives. Thus the electric motor will not only give the most regular speed, as Mr. Woodbury points out, but also the most variable. Evidently there is plenty of room for special applications of this useful machine.

There is a great deal of misunderstanding as to the economy of inspirator compared with a steam pump. Engineers have said: "When I use an injector or inspirator it pulls the steam right down, but with a pump it does not." In these cases the trouble is almost invariably that the injectors are too large, often four or five times as large as they should be. The agent, in order to make more commission, has sold the man a larger injector than he needs, and the result is that probably the majority of injectors in use are too large for the work they are called upon to do. An injector should be so small that it will only feed to a boiler just as much water as is taken from it by steam. The injector, to give the best results, should be constantly in use, feeding all the time. What makes an injector bring down the pressure is that it takes steam and heats the feed water with it. There is no loss of any amount by this operation, but when the injector is large a considerable quantity of water is pumped into the boiler in a short time, and this is what lowers the pressure as well as the withdrawal of the steam to heat the feed water. As a boiler feeder the injector is very economical and much superior, at the proper size, to a pump, even though the pump has a heater attached; but with an injector too large for its work nothing but dissatisfaction results.

CARE AND MANAGEMENT OF A STATIONARY STEAM BOILER.

The first duty of an engineer when he takes charge of an engine and boiler is to examine his boiler for leaks in seams, joints and rivet-holes, and the furnace for burnt out brick, grate bars and door linings. He should see that the safety valve is in good working condition, and that it blows off at the proper pressure of steam, also, that the water is at the proper level. The water should be kept up to the second gauge while working, and up to the third at night. The reason why the water should be raised at night is to prevent it from becoming too low from leakage or evaporation. In case the water should become dangerously low, the engineer should immediately draw the fire and allow the boiler to cool down, and not admit any cold water to the boiler or attempt to raise the safety valve, as it would be positively dangerous. The reason why it would be dangerous is, that it would lessen the pressure in allowing the steam to escape from the boiler, thus allowing water to rise up and come in contact with the overheated iron, and probably cause an explosion.

In case the water supply should be cut off from the boiler for a short time, he should cover his fire with fresh fuel, stop his engine, and keep the regular quantity of water in the boiler until the water supply is renewed.

To get up steam, the engineer should first see that the water is at the proper level; he should then remove all ashes and cinders from the furnace, and cover the grate with a thin layer of coal; and after placing shavings and wood on the coal he may start his fire. The advantage of placing a covering of coal on the grate before the wood and shavings is that it is a saving of fuel, as the heat that would be transmitted to the bars is absorbed by the coal, and the bars are also protected from the extreme heat of the fresh fire.

An engineer should allow his fire to burn gradually when commencing to get up steam from cold water, as by allowing the fuel to burn very rapidly some parts of the boiler become expanded to their utmost limits, while other parts are nearly cold. Of course, a great deal depends upon the time in which he has to raise steam.

An engineer should regulate his fire to a uniform thickness, and not allow any bare places or accumulations of ashes or dead coals in the corners of the furnace, as these places admit great quantities of cold air into the furnace, and render the combustion very imperfect. He should avoid excessive firing as much as possible, as it is attended with more or less danger, because the intense heat repels the water from the surface of the iron and causes the boiler to be burnt. He should keep about six inches of soft coal on the fire, but, in this he should regulate the thickness of the fire according to the capacity of the boiler. If the boiler is too small for the engine the fire should be kept thin, the coal supplied in small quantities and distributed evenly over the grate, and the grate kept as free as possible from ashes and cinders; but if the boiler is extra large for the engine, the thickness of the fire makes but little difference. If the fire becomes very low, he should neither poke nor disturb it, as it would have a tendency to put it entirely out; but he should place shavings, saw dust, wood or greasy waste on the bare places, with a thin covering of coal; then, by opening the draft to its full extent, the fire will soon come up. If it should become necessary to burn wood on a coal fire, it is always best to make an opening through the coal to the grate bars, so that the air from the bottom of the furnace can act directly on the wood and increase the combustion.

He should give great attention to the regulation of the draft in the furnace, as it is one of the most important parts of an engineer's duties, for in fact it is next in importance to the regulation of the water in the boiler. It is well known that immense quantities of fuel are recklessly wasted by ignorance and carelessness in the management of the draft.

There should not be any more draft at any time than would produce a sufficient combustion of the fuel to keep the steam at the working pressure, as by opening the damper to its utmost limits great quantities of heat are carried into the chimney and lost. An engineer cannot carry out this plan in all cases—only in furnaces and boilers that are sufficiently large to furnish the necessary amount of steam without forcing. Of course, where the boiler is too small for the engine, or has not sufficient heating surface, it is impossible to economize fuel.

In some cases it is a good plan to throw a jet of stream under the furnace bars when the draft is insufficient to produce the necessary combustion of the fuel.

Steam or water should not be thrown under the grate bars of locomotive boilers when such boilers are used for stationary engines, as steam or water in the ash-pit forms a lye with the ashes, and corrodes the iron and destroys the water legs of the boiler. The ash-pit should be kept clean, as by allowing the pit to become filled with ashes and cinders the air becomes heated to a high temperature before entering the fire, which naturally interferes with the combustion of the fuel. The grate bars also become overheated, and in many cases badly warped or melted down.

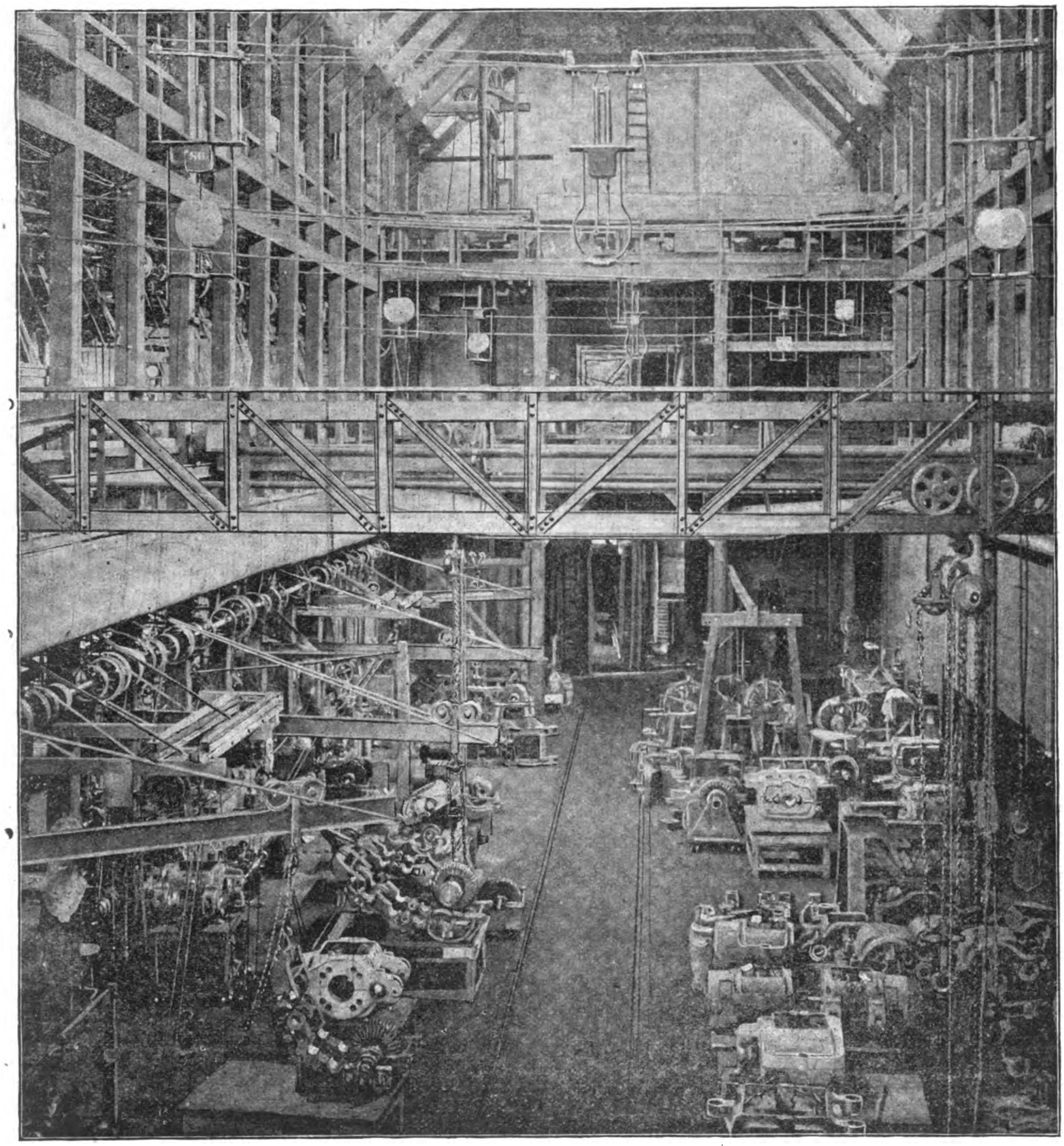
Attention should at all times be paid to the safety valve, and it should be kept in good working order.

In blowing out a boiler rake out all fire from the furnace, and see that the steam is at a pressure of about 40 pounds, and always close the damper. At least an hour should pass between drawing the fire and blowing out the boiler. This will allow the furnace to cool and prevent the boiler from being injured by the heat after the water is all blown out.

The boiler should not be filled with cold water immediately after being blown out, as the introduction of cold water into the boiler before the temperature of the iron becomes lower would, in all probability, cause the boiler to leak. The boiler should be blown out whenever any appearance of mud is found in the water.

When filling the boiler some cock or valve in the steam room should be opened to allow the air to escape. If not, the air would retard the inflow of the water, and also collect in the steam room of the boiler and prevent the regular expansion of the boiler when the fire is started. The steam room in a boiler is that portion of the boiler above the water line. The fire line of the boiler is a longitudinal line above which the fire can not rise on account of the brick-work by which the boiler is surrounded.

The tubes of a boiler should be cleaned once a week, or oftener, and the soot cleaned off the shell of the boiler over the furnace and beyond the bridge-wall. Boilers


MOTOR ASSEMBLING ROOM.—(See page 9.)

should be cleaned at least once in three months, or once a month when the water is very muddy. At such times all stays, braces, seams and angles of the boiler should be examined carefully. The shell of the boiler should also be sounded with a light steel hammer in order to determine its condition.

The steam-gauge should be tested at least once a year. The water-gauge should be kept clean inside and out, and the pipes connecting the same with the boiler-shell should be examined at intervals, as they are liable to become choked with sediment. There should be two fusible plugs, one in a flue over the furnace and one inside of the shell, and they should be kept clean both on the inside and outside of the boiler.

Never clean the inside of a water-gauge glass with a swab having an iron rod as a handle; use a wooden stick, as the iron is liable to cause an abrasion. D. B. D.

◆

A LITTLE wrinkle in babbitting journal boxes is given by a Canadian writer, who thinks it may be of use to others. When lining up a shaft put a small piece of pine wood in the bottom of the box, in length about one and one-half or two inches less than that of the box and in width five-eighths to one and one-half inches, according to the size of the box. Equalize it in the bottom from each end and let the shaft lie on it and pour. After you have scraped out the box remove the piece of pine and substitute some woolen cloth saturated with oil. This prevents the oil from dripping off and not only insures a positive lubrication of the journal but also is clean and requires less oil than other journals.

◆

W. P. DAVIS, of Rochester, N Y., reports business satisfactory. Mr. Davis is the only dealer in machinery and supplies in Western New York. He removed from North Bloomville to Rochester a few years ago and opened a supply store, which has prospered beyond his expectations. He has a factory down on Mill race, where his very popular line of drill presses and cutting-off machines are built. Mr. Davis has an 1892 catalogue of his machinery and supplies, containing some 300 pages, which he will be pleased to send free to any one thinking of purchasing machinery and supplies.

◆

THE W. F. & John Barnes Co., 920 Ruby street, Rockford Ill., makers of small and medium-sized lathes, drill presses and tool grinders, have had a very successful year. They have been unable to accumulate a stock, notwithstanding the increased production. They have some of the best tools in the market and will send a catalogue free to any address.

◆

THE black, solid-looking shadows cast by the electric lights that may be seen in the air when it is not clear suggest that the "cosmic dust" which is supposed to occupy the inter-planetary spaces may be capable, in certain conditions, of showing a profile of the earth under the powerful light of the sun.

◆

THE Cincinnati Milling Machine Co., has issued a handsome catalogue containing very artistic illustrations of the large line of milling machines, their parts, principles, etc., also descriptions and much generally useful information.

Burlington Route New Service.

A through Pullman sleeping car, Chicago to San Francisco, is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11:45 A. M., less than four days en route.

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The Nickel Plate management is pleased to note the substantial manner in which the public show their appreciation of the improved train service on their line. If you have not recently patronized that line, we cordially commend it to you.

A Straw

Shows which way the wind blows and so does the amount of travel on the Nickel Plate show that the new train service has made that line more popular than ever. Rates, however, still remain as low as via any other line.

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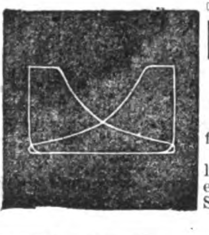
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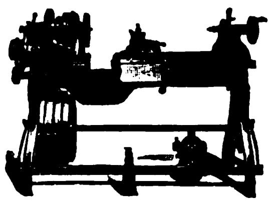

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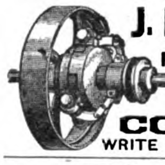
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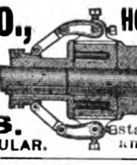
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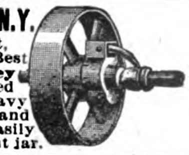

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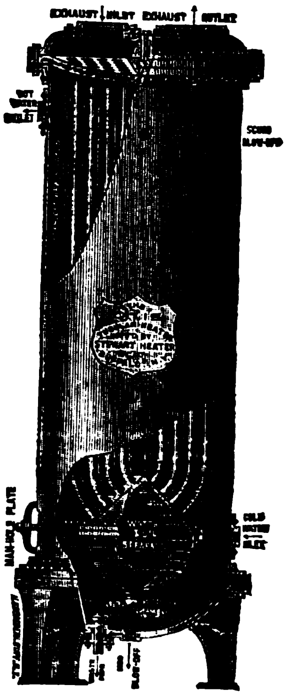

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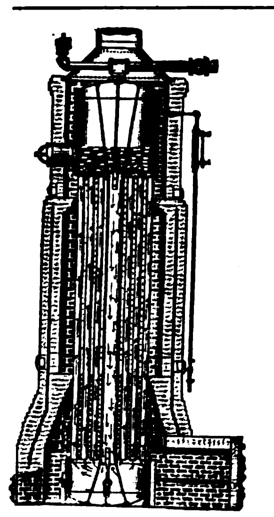

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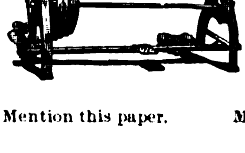

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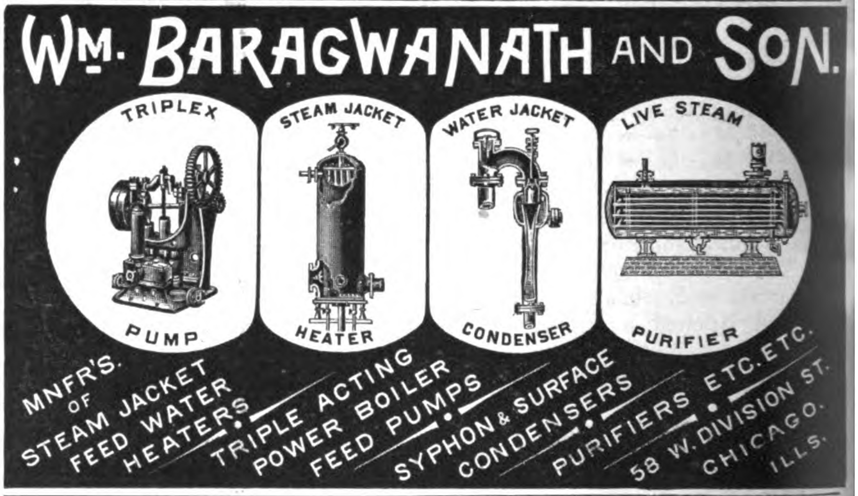
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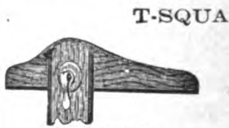

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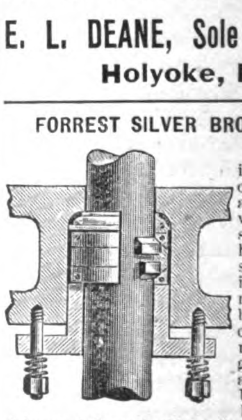

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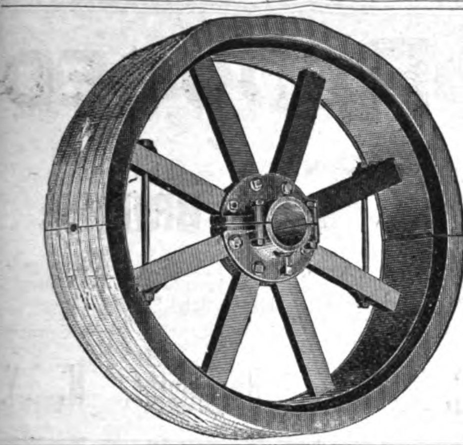

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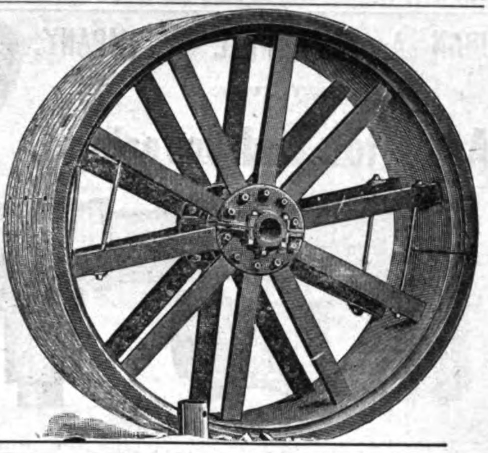

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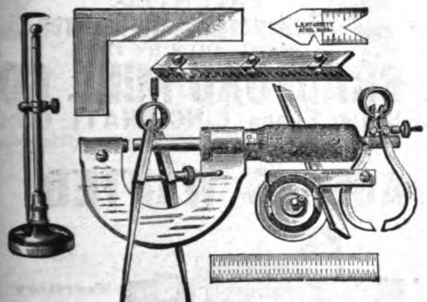

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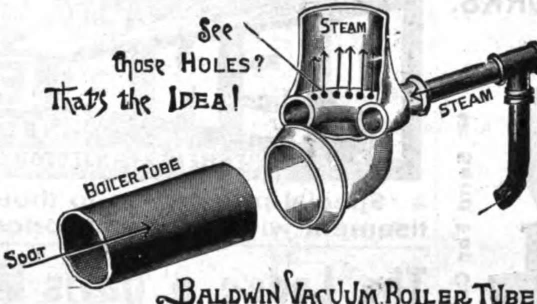

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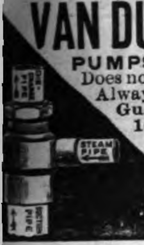

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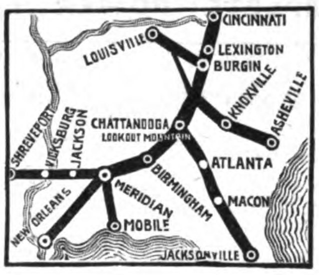

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No. 7 Columbus & Cincinnati Express	†11 50 am
No. 5 Indianapolis & St. Louis Ex	†12 10 pm
No. 27 Columbus Accommodation	4 00 pm
No. 9 Col., Cin. & Ind. Ex	† 8 15 pm
	Arrive.
No. 8 Cin., Col. & Ind. Ex	† 7 30 am
No. 26 Galion Accomodation	9 30 am
No. 12 Col. & Cin. Express	† 2 30 pm
No. 10 Indianapolis & St. Louis Ex	† 2 05 pm
No. 24 Wellington Accommodation	6 40 pm
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No. 18 South Western Limited	† 1 20 am

Nos. 3, 7, 9 and 17 will run to Cincinnati via Columbus. No. 9, leaving at 8 15 p. m., will have sleeper for Cincinnati and Indianapolis.

Departures from South Water Street station five minutes later and arrivals five minutes earlier than above.

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City Ticket Office, 173 Superior St.

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For Uhrichsville and Bellaire	6:15 a m
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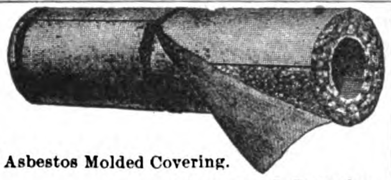

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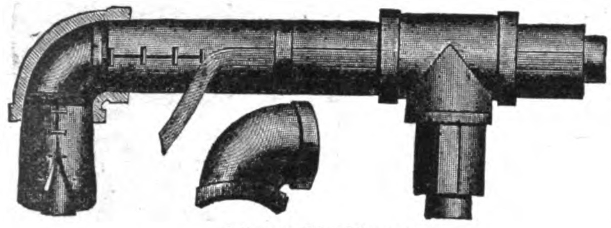

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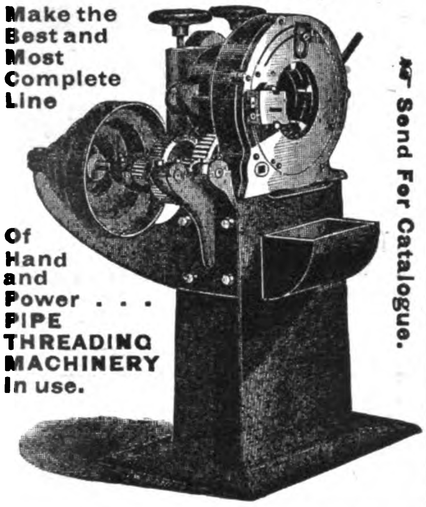

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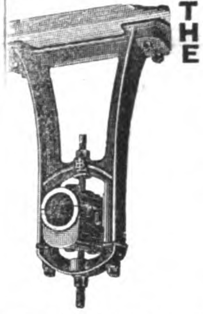

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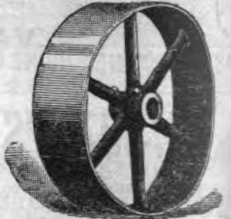

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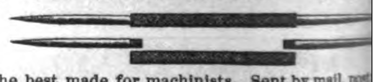

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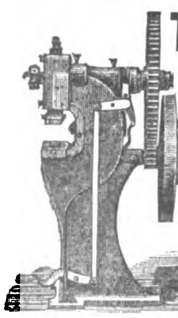

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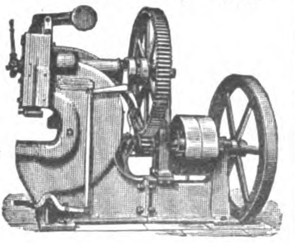

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Obtained By Use of

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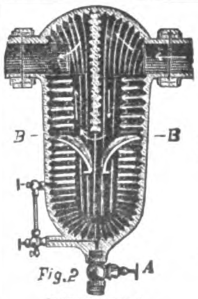

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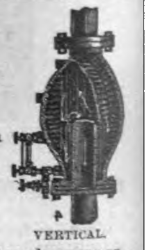

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DEVOTED TO THE SCIENTIFIC CONSTRUCTION AND OPERATION OF MACHINES FOR GENERATING AND UTILIZING POWER, AND FOR ALL OTHER PURPOSES.

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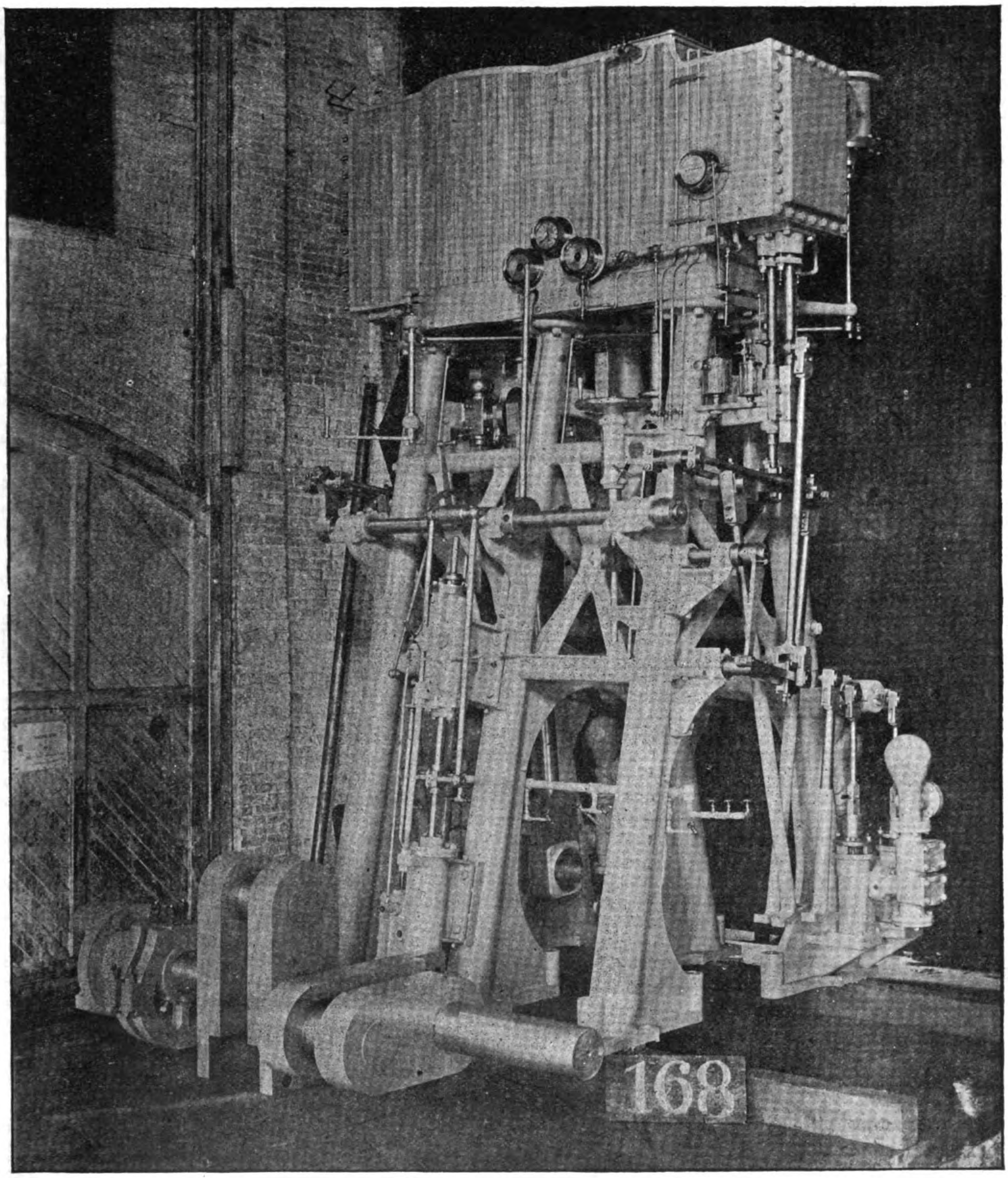
OUND ENGINE OF THE J. J. HILL.

ome time last fall or winter e was built at the Detroit Dry t Works an engine designed to ; condensers attached, such as sed on the salt water. It was achine in the steamer J. J. The illustration on this page m a photograph taken while ngine was in the shop. The number of this engine is 168, showing that its builders have had a large amount of marine construction intrusted to them.



COMPOUND ENGINE OF THE J. J. HILL.

The crank rests on the floor in the foreground.

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Rome, the ancient city in Italy, is to be lighted by electricity generated by the power of the Falls of Tivoli. Six turbines of 2,000 H. P. have been erected, capable of driving dynamos generating currents that will be ample not only for lighting the streets and the public buildings, but also to provide light for private dwellings. These currents are carried across the Campagna 15 miles, and transformed into currents of lower pressure, at a loss of only one-fifth of the initial force. The progress of civilization depends largely on learning how to make nature do our work.

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The number of patents issued from the United States Patent Office in 1790 was three; in 1890 it was 26,292.

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The bleaching of one piece of linen requires 44 distinct operations.

ELECTRICAL

Diving by Electric Light From a Storage Battery.

A submarine diver with copper handgear and lead-weighted feet walked down a ladder into the Detroit river at the foot of Griswold street at 9 o'clock yesterday morning. A half a minute later there was a brilliant flash of light in the water. The diver James S. Quinn, came to the surface like a shot, considerably startled.

It was Detroit's first submarine lamp that flashed. The diver wasn't expecting it. It was intended as a surprise to him. It proved a most effectual one. A few energetic mutterings came from within his copper headgear, but an explanation was given by the laughing attendants and he went below the surface again. Instead of feeling around in the dark for the hole in the hull of the schooner Nelson and driving nails by guesswork, as usual, the diver patched to hole by electric light as rapidly as though in daylight and above the water.

The hole was three feet long and eighteen inches wide. Quinn worked at it unremittingly two hours and a half before it was mended. Then he came to the surface and declared that the scheme worked like a charm.

His brother, John S. Quinn, Detroit's veteran diver, was no less enthusiastic. He exhibits the lamp proudly now at the warehouse at the foot of Griswold street. He can't say too much in praise of it.

"Instead of feeling around in the murkey river water to drive nails," he said "or mend a broken bucket on a wheel we can work night or day in perfect light."

A submarine lamp is no new thing, although J. S. Quinn asserts this is the first one Detroit has seen. But the principle of this particular lamp is said to be a novelty, never seen on the great lakes, and one that is not known to have been tried before in any quarter of the globe.

It is the first submarine lamp run by storage batteries. Formerly submarine lamps had to be accompanied by a dynamo, representing no small investment of capital in itself. Now, instead of carrying a heavy dynamo miles upon miles to a wreck the diver simply takes a few light, small storage boxes..

The lamp and outfit were got up by the Standard Electric Company.

"The lamp is thirty-two-candle power," said Mr. Frisbie of the company, "and is the first storage battery submarine lamp I know of. It will cast light from five to ten feet at any depth below the surface.

"It arrived in the morning, a few hours before we made the experiment. It is run by ten storage cells of 200 ampheres and a capacity of twenty volts. It will run for 40 hours. The cells used for the lamp were in service for lighting the Newberry wedding at Grosse Pointe, and for running the car to Mt. Clemens and Royal Oak, and also for the car we ran on the Fort street railway. It demonstrates the wearing ability pretty well as those cells have been used for seventeen months."

The lamp is in a small cage a foot and a half high, with brass rods running at intervals from the lead bottom to the brass top. Within this cage is a heavy glass globe, screwed tightly, with rubber packing. Within the globe is the incandescent lamp. The first globe, it is asserted, will stand the water pressure at a depth of fifty feet. The wire are enclosed in a long rubber hose.

The schooner Nelson, which was sunk in a collision at Lime Kiln Crossing by the Susan E. Peck, had a hole just below the bilge, or eight feet below the surface. It was this hole that was mended temporarily by Diver Quinn.

Fence Telephone.

C. C. Jennings, formerly Superintendent of the Brush Electric Light Co., of Buffalo, and now a resident of Detroit, has patented a system of telephonic communication by means of which barbed wire fences can be utilized between railroad stations, farmers' houses and large ranches. The patent involves the use of a portable transmitter, or telephone, which can be easily attached to the barbed wire at any point, and by which messages can be received or sent to railroad stations, or other places, at which there are regular telephones.

The parties interested recently applied to the Michigan Central officials for permission to demonstrate, at their own expense, the practicability of the invention. The proposition was accepted. A line of barbed wire fence, commencing at Wayne Junction and running west some three miles, was selected for the experiment. The portable transmitter was attached to the wire at intervals of a quarter of a mile, and it was found to work perfectly. All messages sent over it to Wayne Junction were plainly heard and answered. The portable transmitter and hand 'phone weighs about two and a half pounds, requires no battery, and is carried in a leather case, like a field glass. The act of attaching it to the wire rings up the station, and it therefore requires no callbox.

The advantages of such a system to railroads are obvious. If an accident occurs the conductor of a train can attach his transmitter to the fence, calling up the nearest station, which forthwith notifies the train dispatcher at headquarters. If a track walker or section hand finds a broken rail, a washout, or other obstruction, he can do the same. At present, if a section boss finds that he needs additional material, such as new timber, a piece of rail, etc., he has to send a hand car with an order to the nearest station, to have it forwarded by the next train. This trouble and delay can be obviated by the new telephone system.

The dreary isolation of thinly populated rural communities, and the lack of prompt communication between distant points on large ranches, would also be alleviated.

A public exhibition of the system will be held on the line of the Michigan Central Railroad in the near future.

Electric Welding.

A peculiar physiological effect of the light produced in electric welding machines is thus recorded in London Iron: "A section of the men employed at the Kolomna Iron Works, situated near Moscow, has lately had some unpleasant experiences with electric welding, which, with the aid of 500 accumulators, is there practised according to the Benardos process. While engaged on the trying work the artificers' eyes were protected by tinted glasses, but the skin being exposed, the following symptoms were manifested: burning sensation on the skin and in the eyes; in from three to four hours discharges from the nose and the eyes; three to four hours later a dry cough; four or five hours later swelling of the skin and development of other symptoms; eight to ten hours from the commencement of the disorder continuous irritation of the eyes, lasting from four to six hours; and finally, coloring of the skin. Then the various effects ceased, and the skin began to peel. On the third day the cuticle had completely decorticated, and by the sixth all the painful symptoms disappeared. But for weeks afterwards the skin remained colored. These effects, it would seem, are exactly the same as those which are induced under scorching by the sun. The best protection which can be afforded the workmen against the evils mentioned, Mons. Maklakoff, the manager of the works, believes, consists in a covering of yellow waxed cloth or red and green veils."

Electrical Terms.

We have given in these columns many explanations and illustrations of the meaning of electrical terms by comparison. Mr. R. G. Davis, in the Marine Review, treats the subject in the following:

The whole question of electrical distribution may be properly illustrated by its analogy to hydraulics. The dynamo is essentially a rotary pump, but pumping electricity instead of water. If the discharge pipe of a rotary pump be carried around through a given circuit and connected with a suction, both pump and pipes being full of water, the movement of the pump will obviously cause the water to flow in one direction, producing a continuous current of water. Substitute dynamo for pump, wire for pipe and electricity for water, and conception of electrical transmission by the continuous current is at once clear as to its elementary phenomena. We will bracket the analagous electrical terms; then we may say that a certain number of pounds [volts] of pressure are required to overcome the friction [resistance] of the pipe [wire] in order that the water [current] may flow at the rate of so many gallons [amperes] per minute. The larger pipe [wire] the more water [current] can be carried and the less will be the friction [resistance;] or per contra, the smaller the pipe [wire] the less the quantity [amperes] per minute and the greater friction [resistance]. Manifestly the pipe [wire] might be so small that the friction [resistance] would absorb a very
large proportion of the power
the pump [dynamo] leaving
little remaining for useful effec
therefore the two horns of
dilemma are: If the pipe [wire
too large it will cost too much;
too small the loss will be too gr
The electrical appliances are
analagous to engineering ap
ances. The switches are val
the reversible strips are the saf
valves, the contacts are the
fittings. If the contact is ins
cient to carry the current there
be a leak [drop] in the curr
The volt meter is the press
gauge; the ammeter is the sam
the water or gas meter, the recor
of quantity consumed.

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METAL CUTTING TOOLS.—IV.

DRILLS.

Rotating tools, such as dr
reamers, taps, boring tools, e
may next be considered in the or
named. The requirements fo
properly made drill, while ad
ting of an almost endless variet
forms, to suit different classes
work, are similar in all essen
features, not only one form to
others, but also to the class of t
previously referred to—that is
course, as regards fundame
principles of cutting. The
common form of drill is the
fashioned forged one, now gene
ly used for rough work only, w
accuracy of size and position of
hole are not important. For
purposes they are undoubtedly
ferable to the more elaborate st
as, if properly made and gro
they are capable of working
rapidly as the latter, will
rough usage without great liab
to injury, and last, but not l
they are cheap. Since the ad
of round bar steel of suitable
ity for tool purposes it is usua
make several sizes of drills from
size of bar, so that they will
require the use of too great a
ber of drill sockets. This nec
tates considerable forging to
out the body of drill for the sm
sizes; but as it has its compens
in the improved quality of the
from the extra working, it ca
be considered very objection
on account of the increased co
forging, which in any case is
great and does not occur very
The shank, being the originals
and size of the bar, requires
use of a straight socket, the
being held therein by a hard
point (properly steel) set s
which should seat on a good
flat filed on the drill shank to g
against slipping in case the
should catch. Only suffi
length of body should be d
out to allow proper clearance
the maximum depth of hol
which the drill is intended t
used; but in order to econo
steel the shank may be made
enough to admit of conside
reforging as necessary through
repeated grinding and dressin
the point. In many shops th
of octagonal steel is still adher
and this, of course, renders it

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essary for the shanks to be turned to fit the socket. If turned at all, they may just as well be made taper to fit the standard socket, and thereby render them interchangeable with the finer class of drills used for more accurate work.

In forging the body, it is impossible to get a first class job if it be drawn out too rapidly by heavy blows of the helper's sledge. The effect of this is to torture the metal to such an extent as to cause it to deteriorate, rather than improve, by the working. The proper method is to neck down from the shank, over the horn of the anvil, leaving just stock enough to form the proper length of body, and the latter should then be drawn out square the whole length, then to an octagon, and finially rounded up by the hand hammer. The sledge used should be light—from 4 to 6 pounds for the smaller sizes of drills—and the blows light and quick. As soon as the steel has cooled down to a dull red heat, the working should be discontinued until it has been reheated. The degree of heat allowable varies somewhat with different makes of steel, but, as a rule, it should not exceed 1500°—the so-called cherry red. Blacksmiths, however, seem to have very elastic ideas of this conventional limit, and it is more common to see tool steel worked at a bright red, nearly orange, which is many degrees above the proper temperature, and cannot fail to injure the steel.

After the full length of body is drawn out round, the end should be flattened to the required thickness for the point, and taper slowly and uniformly until it vanishes into the round. The thickness of point may be considered as a percentage of the width, and as a rule for average work should be about 15 per cent. This, of course, applies only to the smaller sizes, say 1 inch and under, as it would be manifestly improper to make the point of a 2 inch drill 3-10 inch. Within the limits given, however, the proportion holds good, subject to such modifications as the nature of the material or character of the work may require. As the use of the forged drill for holes above one inch diameter is not desirable for economic considerations, except in special cases, it is unnecessary to refer to larger sizes.

As in lathe tools, the crucial feature of the drill is the angle of cut and clearance. The line of cutting is not radial, as would appear at first glance, but tangent to a circle represented by the thickness of point, and therefore the edge has a slight draw, which materially assists its clean cutting. The angle of clearance back from the edge varies according to the character of material; but as this is merely a matter of grinding, it is very easily adapted to the requirements. The angle should be only sufficient to allow the edge to bear in advance, and all behind it to clear the inclined surface caused by the continuous feed. As this is very slight, it will readily be seen that the angle necessary to afford ample clearance may be extremely small, and the proper cutting action of edge can only thus be secured. For cast iron and brass there is no gain from making the face or front side above the edge otherwise than perfectly flat. For wrought iron, steel and the tough copper alloys, the drill will cut more freely and rapidly if a slight lip be ground above the edge, so as to throw the latter back sufficiently to give it the same character of cut as that of the diamond-point lathe tool. There is nothing gained by forging the lip, as it can be just as readily ground without imposing this extra work on the tool dresser.

The degree of clearance on the side edges should be as small as possible to make sure that there is any, though it is of the utmost importance to see that there is some, and not have the highest point back of the edge, as is so common a fault. This, more than any other cause, prevents the drill from doing its work properly, as it makes the cutting edge less than the size of hole, and causes the side edges to grind and tear their way in following, until the frictional heat generated causes the temper to be drawn, and the familiar "squeaking" begins. Much valuable time would be saved if workmen made it a rule to stop and investigate as soon as any such evidences of improper working is noticed, instead of crowding down the feed by main strength until the drill twists off or is so badly burned as to need the services of the tool dresser. Be sure there is side clearance, and if the material to be drilled is not too hard for the temper of the drill, there should be neither music nor any other difficulties in the way of its cutting freely.

The angle of point should be from 110° to 120°, or 55° to 60° each side of the axis. A more acute angle is sometimes desirable, particularly when it is necessary to drill the hole accurately to a circle locating its position, as the drill will more readily follow the center chisel in drawing to the line. For all ordinary materials the temper of the drill, by color, should be from dark brown to brownish purple. This is as hard as is necessary to enable it to cut freely and hold its edge; and if made harder it will almost invariably result in breakage. The proper speed varies considerably with different materials, but it should be as quick as possible so long as there is no tendency to heating. There seems to be an intuitive perception by the feel of the feed when the drill is working properly—whether as speed or any other point—as it should never be necessary to use any considerable force or exertion to feed, if everything is right, even for drills of large sizes. Cast iron and brass should by drilled dry; steel, wrought iron and tough alloys with oils, soap and water or an emulsion of the two, the last being probably the best as well as the cheapest lubricant for the purpose.

It is sometimes necessary to drill metal which is very hard—chilled iron or hardened steel, for instance—and this necessitates a very different temper in the tool, as well as a change in its shape and manipulation. The drill must always be many degrees harder than the metal it is intended to cut. For example, a saw blade is of the temper represented by a greenish blue color, and is soft enough to file. An ordinary drill, at the purple temper, or even brown, is obviously much harder, and yet it will not drill the saw blade—at least not freely, though it may be possible to worry it through by main force and repeated grindings. The very hardest temper at which the drill will have the strength required to enable it to resist breakage will not enable it to drill freely a spring or saw temper, and the greatest care is necessary in using it for such work.

But it is not usual that the emergency arises in which even full hard steel must be drilled, and although it is a wearisome operation, requiring patience and persistence, it can be accomplished. For instance, safe makers built their burglar-proof safes and bank vaults of the quality of steel capable of the highest degree of hardness, for the very purpose of rendering them proof against the burglar's drill. Yet it is not an unfrequent occurrence for such a safe or vault to be burglarized by expert cracksmen, whose method of operation is almost invariably to drill a hole in such a position near the lock as to enable them to reach and throw the bolt work. Also, sometimes, the banker misses his combination, or something happens to the time lock. Then it becomes necessary for the safe maker to force an entrance, and as bank locks cannot be picked, he must resort to the burglar's method of drilling. The question is, then, how can the drill cut metal as hard or harder than itself? Obviously it cannot, and in order to secure the necessary hardness to enable it to cut, and at the same time sufficient strength to resist the heavy pressure required, some special method of hardening must be employed. Most men in this line of business have their own process and keep it a very closely guarded secret.

The essential features of the manipulation of a drill for such work are a very slow speed of revolution, perfectly rigid machine—be it lathe or drill press, or ratchet for hand drilling—and a powerful feed device, which is capable of forcing the drill into the the hardened metal sufficiently to compel it to cut. It must be remembered that if the drill makes but a single revolution with insufficient feed pressure it will become dulled beyond the possibility of cutting until it is reground. The reason of this is very simpie; the great hardness of the metal enables it to resist a very heavy pressure before giving way to the penetrating power of the drill, and any degree short of such pressure, no matter how little, will cause the edge of drill, whose actual surface of contact is so very small, to drive around the entire surface upon which it is seated, which is proportionately very great, and the edge is dulled by mere abrasion, similar to that produced by a soft metal saw cutting hardened steel. Drills for this duty should always be of the forged pattern, of the very best quality of steel attainable, and forged and hardened iu the most careful manner. They should always be filed into shape before hardening, so as to make it necessary to do only so much grinding after as will give keen cutting edges. Hard steel may be turned and planed by following the same general rules as to form of cutting edges of the tool, slow motion, proper stiffness of the machine, and power of feed. The same hardening process also may be used. The chilled rolls used for plate and sheet mills and for calenders are turned in a lathe particularly adapted to the purpose, in which the tool is simply laid against a shoulder on the rest without any holding device whatever. Continuous feeds are not used, but instead the tool rest is forced along, about 4 inches at a time (for each revolution), by means of a rack or ratchet and a long bar.

In cutting hard metal we have an exceptional set of conditions to deal with, whether the operation be turning, planing or drilling, and consequently an exception must be made to the general rule mentioned in reference to working with ordinarily soft material—i. e., that properly made tools do not require forcing in order to cut freely. If great force is not used on very hard metal there will be no cutting, and an inexperienced hand on this class of work will invariably fail to accomplish it, and will lay the blame on the want of sufficient hardness in the tool, when the fault lies entirely in his method of using it.—[Iron Age.

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Getting It Down Fine in Screw Manufacture.

An instance of remarkably fine mechanical work is that described by Prof. Rowland, the distinguished microscopist, says an exchange, who has now succeeded in manufacturing a screw for his dividing engine which is said to be more nearly perfect than any other of the kind ever produced. It is made of the best steel, is 1½″ in diameter, 17″ long, and with 20 threads per inch; was first cut in a lathe in the ordinary manner, then ground by using a nut equal to it in length, which was placed on it with washed emery, and the screw revolved under a bath of water and oil maintained at a constant temperature. The grinding required about three weeks. It is to be used mainly in ruling gratings for spectroscopes, and it is thought will be capable of ruling a million of lines to an inch. In the head attached to the screw there are a thousand notches, so that the movement of a notch advances the thread 1-20,000 of an inch. It may be remarked that M. Behrens has lately stated to the Amsterdam Academy of Sciences that, under high powers of the microscope, the network in hardened steel may be made visible on polished slices without etching or annealing—the dark, sinuous lines answering to the bright ones shown by Sorby on etched slices, and it is proved that hardened steel contains hard granules bound up in a matrix of soft iron.

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CLEVELAND and Hardwick have issued a new catalogue of their engines and boilers. It contains illustrations and descriptions of their line of stationary, slide valve engines from 20 to 125 H. P., both center and side crank, their double engine with links, tumbling shaft, reversing bar, etc., attached, portable engines with and without wheels, vertical and horizontal boilers, portable boilers, boiler settings, furnaces, etc. The firm of Cleveland and Hardwick is located at Erie, Pa., and is one of the large concerns of that celebrated manufacturing city.

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THEY DEMAND THAT CONGRESS RESTRICT IMMIGRATION.

The press of the country have turned their attention to the subject of immigration, of late, with an energy that is gratifying, and the unanimity of opinion is significant. All agree that the legislation most necessary is on this question, and all urge Congress to pass a law directly it convenes, dealing with immigration in the proper way. Just what should be done the editors are not decided. Some think that it should be suspended altogether. Senator Chandler, of New Hampshire, is strongly of that opinion, and not a few of the newspapers cencur with him. We think that suspension is exactly the right course. It sounds radical to some and might be considered a hardship. But with a few just and humane exceptions, there would be no harsh features in it. Families should not be separated. A man already here should be permitted to bring his immediate family, provided he is able to show that he can support them. But relationship should be proven beyond a doubt.

But if we cannot shut them out alltogetner, let us insist that they be sifted very finely, and those not eligable kept out. No hastily devised, ill-considered measure will accomplish this. The steamship companies and the classes here who favor wide-open gates, will intrigue to evade the law and assist the refuse to get entrance. They are very cunning. The law should be so perfectly framed that no such loopholes can be found and that no construction contrary to its spirit can be placed upon any of its clauses by corrupt or hostile official. Some believe that a per capita tax is the proper thing, some that consular inspection is the only effective plan.

If suspension cannot be had we believe that consular inspection is preferable. In the first place, the Slavs and Italians should be nearly shut out altogether. None should be given a passport who can not show that he is a skilled workman and has earned the best wages generally paid for skilled work. These classes are contented with their condition and will not want to emigrate. Towards all countries, a good physical and moral test should be enforced. The applicant should be required to prove that he is not a pauper nor on the verge of pauperism, that he has never been convicted of a crime or misdemeanor, that he is sound mentally and physically and has some trade or regular occupation. When not entirely satisfied with the evidence, a deposit sufficient to return him to his native country in case he proves, after coming here, to have been misrepresented, should be required before issuing a passport. There should be an inspection at every port of entry in this country, and no one not holding a consular passport permitted to land. The Canadian and Mexican borders should be thoroughly watched to prevent the inelligible from slipping in unawares.

It is amazing that America has permitted herself to be imposed upon so long. It has been proved over and over again that many countries, notably Great Britain, have regularly organized bureaus for transporting chronic criminals, paupers and those dependent upon charity, whether from disease or poverty, to the United States. This is an outrage, which if commited in certain other ways, would have caused the roll of the drum to sound from one ocean to the other, and brought on war at once. It is time to stop all this. We ought not to be the cesspool for the rubbish humanity of the world. We have stood it long enough. Besides, there are so many cheap foreigners on our shores that our citizens of foreign and native birth who expect always to stay here can scarcely live on the reduced wages this competition has compelled them to work for. We have more than we want of labor. Let us look out for that already here.

We are much pleased to see the campaign go forward. Let every newspaper demand effective and immediate action by Congress, so that our ports shall be closed before next spring opens and thus prevent the awful Asiatic plague from coming to our shores—as it most certainly will next year if immigrants are permitted to pour in as they did last spring and summer.

APPRENTICESHIP.

That the old system of apprenticeship, except in remote country places, is gone never to return, is obvious. It had its uses and made some of the most skilled mechanics the world has ever seen, some with combinations of ingenuity and wide zone of practice that the world will probably never again see after this generation. It had also its abuses, and gradually became out of line with the advancement of civilization. Other features of our society, in its modern development, militated against the system, until it is now practically superseded. It has been some years since enforced service has been recognized in this country. If a boy remained till his trade was learned, it was not because of any hold his employer had on him by virtue of his apprenticeship contract. He felt at liberty to go to another shop to finish his trade.

Many regret the decay of the apprenticeship system. Its destruction is largely due to un-American ideas. The immigrants who have arrived within the last dozen years and taken up trades have developed a hostility to apprentices, believing that by preventing employers from educating mechanics they would enhance the value of their own services and reduce the supply of labor. They have practically given the apprentice system its death blow, but in its place is coming up an institution beyond their control that will be a much more potent factor in making mechanics than the apprentice system. That is, the trade school. There are different views published concerning the utility and merit of the trade school as a means of making good, practical mechanics. With all respect to those who hold a contrary opinion, we believe that they are doing a good and thorough work, and that they will in a very few years not only supplant the apprentice custom, but do the work of making good mechanics in a thorough, satisfactory manner.

One special advantage will accrue to the mechanical trades from this kind of a feeder. Those coming into the trades will he better informed. While in the trade school learning the skill of a line of mechanical work is the principal object, the general education of the pupil is not neglected, and every one coming out of a properly conducted trade school will have a degree of intelligence above the average of the present.

OPEN IT SUNDAYS AND EVENINGS.

There has been considerable discussion of the question whether the World's Fair should be open Sunday. Undoubtedly the first thought of nearly every one was that it might well be closed on that day. We were inclined to that opinion ourselves. But on mature reflection considerations enter into the question which one is not likely to appreciate at the first glance. The crowd will be an unprecedented one in size, and if the chief attraction is closed, the drinking and other worse resorts will receive a patronage that would not otherwise be had, and from a class that might not frequent them except for the absence of some other place to go. From a moral standpoint, the opening of the World's Fair on Sunday is desirable.

Another reason. Those who go will be present in Chicago principally for the purpose of witnessing the great display. They will be taxed heavily for maintenance while there, and the sooner they have seen what they wished to the sooner they can depart.

Many objected to Sunday opening because they thought the first day of the week would be the same as the following six—that everything would move on as usual. This they considered too great a desecration of the Sabbath to be permitted. But such an impression is entirely wrong. It is proposed to open the grounds and buildings, but to keep every kind of business and the movements incidental to the week days at a standstill. Religious services will be held there, and no more desecration of the sacred day will result from its being thus opened than from attendanee at church. In the interests of the prevention of immorality we strongly urge Congress to enact the legislation permitting the Great Exposition to be opened on Sunday.

There has been a movement also to secure evening opening. The electrical industries can make no showing at all without it. They will provide a display well worth traveling around the world to see if they can be given darkness to aid the exhibit and render it attractive. Evening opening is necessary, and the denial of this request of the electrical people and public is not to be thought of.

Let the great fair be open from 7 in the morning to 10 at night, every day of the week.

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THE depression in trade predicted by pessimists has not arrived. Why an administration of Americans should legislate against the best interests of all, as any action checking the construction of manufactories to any appreciable extent would be, we are not able to understand. We do not believe that legislation hostile to the best interests of the country need be looked for.

QUESTIONS AND ANSWERS

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(470.) J. S. De Graw Milling Co., ——, write: "Please give me some general information on the height of chimneys for different capacity of boilers, also on the shape of flue inside. We want to erect a stack for a boiler, the capacity of which we do not now know. It will be from 75 to 150 horse power. We may have two plants and two stacks, and if so the boiler capacity in each will be half what it would be if only one is erected. You might, therefore, give me data on the proper height of chimney for 50, 60, 80, 100, 125 and 150 horse power boilers; also how to build the flue if we want it square, and how if round, to get the same draft." A.—For no boiler should the chimney be less than 50 feet high. With a 50 H. P. boiler, a chimney 50 feet high should have a flue area of 450 square inches; one 60 feet high, 433.5 inches; one 70 feet high, 417 inches; one 80 feet high, 400.5 inches. For a 60 H. P. boiler, a chimney 50 feet high, 540 square inches; 60 feet high, 520.2 square inches; 70 feet high, 500.4 square inches; 80 feet high, 480 square inches and 90 feet high 460.8 square inches. For an 80 H. P. boiler, chimney 50 feet, 720; 60 feet, 693.6; 70 feet, 667.2; 80 feet, 640.8; 90 feet, 614.4; 100 feet, 588. For 100 H. P. boiler, chimney 50 feet, 900; 60 feet, 867; 70 feet, 834; 80 feet, 801; 90 feet, 768; 100 feet, 735; 120 feet, 669; 130 feet, 636. For 125 H. P. boiler, chimney should not be less than 70 feet high. This should be 1042.25; 80 feet, 1001.25; 90 feet, 960; 100 feet, 918; 120 feet, 836.25; 130 feet, 795. For a 150 H. P. boiler, chimney 80 feet, 1201.5; 90 feet, 1152; 100 feet, 1102.5; 120 feet, 1003.5; 130 feet, 954; 140 feet, 904.5; 150 feet, 855. It makes no difference whether the flue is square or round, if it has the proper area. You know how to find the dimensions of one side of a square chimney—simply by ascertaining the square root of the right area of your chimney. To find the proper diameter of your chimney, knowing the area in inches, divide area by .7854 and the square root of the result will be the diameter in inches. There is some difference of opinion between mechanical engineers in regard to the proper size and height of chimneys, but in practice there is but little difference between them. A good engineering work is what you want. All such information is contained in them.

(471.) M. B., writes: "I have built a small dynamo with the two outside magnets of the usual shape, almost encircling the armature; but both north pole. Then on the main shaft and inside the armature, which is hollow, are a series of small magnets built in a circle. These are something like the magnets on an alternating machine; but the poles are out and are all south. They are insulated from the shaft; but are keyed fast to it, and are excited by the same current as the large outside ones, through a wire running inside the shaft. The armature can be wound in any practical form so it complies with the other requirements, and is to run loose on the shaft. All little difficulties, such as oiling, etc., have been overcome by a special designing of the parts. My object in building a machine in this way was to bring the coils nearer the magnets, and to have them under their influence all the time. The machine I have built is too small to judge of its efficiency; so would like your opinion on it. Has a machine of this type ever been built or tried? A.—The advantages of a construction of this kind are somewhat difficult to see. A bridging over of the air spaces between the poles of the two outer magnets might be attained, but the advantages are remote and undoubtedly the details of construction would be unduly complicated, the commutation would likewise be troublesome unless the coils of the armature and the internal magnets bore a direct relation te each other in number. We know of no similar construction.

(472.) R. P., Waukegon, Ill., asks: "Can you tell me how I can remove ink from paper without scratching the surface? I have some drawings which I wish to alter, and would like to know how to do it without injury to the drawing." A.—We have lately seen a preparation that took off the ink very satisfactorily. It consists of a pencil, which is moistened and rubbed over the ink, after which chloride of lime is applied. The name of the concern making it, is the Monroe Ink Eraser Co., La Crosse, Wis.

(473.) Chas. R. Fox, Jefferson, O., writes: "I desire to ask a few questions. They may not be of general interest, but they are very important to me. 1. I desire to learn the machinist's trade, and want to inquire what kind of a shop is best to learn the trade in. I have a high school education and want to learn the whole trade and want to know what kind of shop is best. About how long will it take for a hard working man to learn the trade? 2. Does the valve of a safety valve open each way?" A.—1. If you wish to confine your apprenticeship to one shop, we would advise you to enter a good construction shop where first class machinery is built. An engine shop would be about the right one. There you will be obliged to learn the principles and the reason for doing every operation. There are no secrets. But if you can, it would be some advantage to get a year in a first class country machine shop, where repair work and construction is done. From there you would do well to enter such a shop as mentioned above. The time usually required of an apprentice at the machinist's trade, is three years. That is certainly long enough for a bright young man to learn it thoroughly, if he has any advantages. 2. The valve can open but one way.

☛Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

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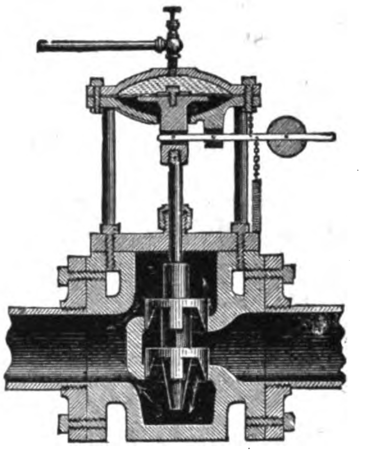
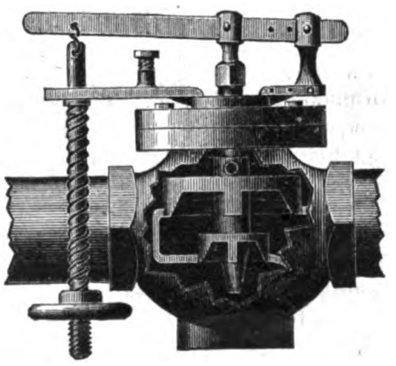
ACTON'S PRESSURE REGULATORS.

The figures shows a well known pressure regulating valve now in general use in many of the largest concerns on the continent, where close regulation of pressure is taken into consideration.

This regulator will automatically control the pressure at any point, regardless of the initial pressure, and cannot jump, owing to the regulator valve, which causes a slow displacement of the water from one chamber into the other, thus causing the most perfect motion which pressure valves have been brought to. Noiseless motion when working is one of its merits. There are no stuffing boxes to leak. It has two flexible diaphragms, and should one give out, there is no necessity to stop the working of the valve to have it replaced, for the valve can be worked on the other, but will not work on the same steady, uniform motion as it would on two. Should both give out, the chain is hooked up and the piston valve closed. In many instances this valve has replaced those of other manufacture. The wire drawing of steam, whistling and jumping cannot, it is claimed, take place for the above reason. Steady motion saves the coal pile, which this has done in some, to the amount of $3,000 in twelve months. Some concerns have 20 of these in use and buy no other. Mr. Acton guarantees perfect regulation. He sends them on trial to responsible parties.



PRESSURE REGULATING VALVE.



BACK PRESSURE OR RELIEF VALVE.

One style is designed to control high pressure, such as that of steam pumps of hydraulic elevators, fire pumps, water works, electric light engines, or where there is more pressure than is required. In connecting with hydraulic pumps the pipe at the top must be connected with the discharge side of the water cylinder to control the steam pressure; the regulating valve on top and the combination on the spring will stop the jump usually known. In passenger elevators this is indispensable. The back pressure or relief valve is also illustrated.

The following letter from an engineer having one in operation will, in this connection, be interesting:

New York, Nov. 22, 1892.

Mr. John Acton,
191-193 Worth St, N. Y.

Dear Sir:—In answer to your letter of recent date, as to the workings of your steam appliance put into the Mahoney building, will say that the regulator operates on scarcely any perceptible variation. Your back pressure valve is on the true principle, where something noiseless and positive is desired, as in my case, where a 300 horse power Corliss exhaust direct into it. I believe the piston type will wear for many years, while the disc type wears and becomes oval and causes continual annoyance. This is something which in my opinion as stationary engineer for 17 years, is now indispensable.

Yours truly,
Wm. House,
Deputy No. 1, N. A. S. E.
Engineer for Wyncook and Hallenba.

The western agents for this device are the Chicago Engineer's Supply Co., 108 E. Lake St., Chicago, Ill.

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The Cook Water Tube Boiler.

The Aultman and Taylor Machinery Co., of Mansfield, O., have installed a number of the new Cook water tube boilers since they began the manufacture of that boiler a few months ago. The Union Rolling Mill Co., of Cleveland, was one of the first to order, and the boiler is doing splendid work there. All the buyers of these boilers report great economy and are entirely satisfied.

This boiler was invented by H. F. Cook, an engineer and boiler inspector of large experience, and is designed for the utilization of waste heat from furnaces and rolling mills. The circulation is perfect, and no inscrustation to any appreciable extent has been formed in those now in use.

Some time ago we published a description of this boiler, and now take pleasure in stating that the several plants equipped with them have worked so satisfactorily. Any firm using waste heat for generating steam would do well to write to the manufacturers for tests and particulars of this excellent boiler.

◆

The city contract for gas in Singapore, India, expires Jan. 1, and it is expected that the Sultan will adopt the electric light. The estimated cost of a plant is $350,000. There is already a small Thomson-Houston plant in the city. Jahore is expected to have a plant of 50 arc lights, and the two contracts are to be let at the same time.

◆

An important consolidation of electric companies has taken place in Cleveland, O. The Cleveland Company, the Brush Company and the new General Electric Company are in the combination, and the power said to be back of it and controlling it is the General Electric Company, of New York.

PRACTICAL LETTERS

How He Bored the Hole.

EDITOR SCIENTIFIC MACHINIST:

Mr. R., who is an engineer of ability occasionally has to make trips to the interior of tropical countries in the interest of a Manufacturing Co. On one occasion a spur wheel for a sugar mill had been sent out to replace one broken, and through some misunderstanding the gear had been bored out about one-half inch too small.

Mr. R., who was busy with other machinery, detected that the hole was not large enough, but said nothing.

Some of the peones, however, were soon found to be comparing the size of the bore of the wheel and the shaft on which it was intended to go, by making a mark on a piece of wood.

Coming in a body to Mr. R., they declared the hole was too small. Mr. R. told them it would go on all right; to this however, the peones would not listen, declaring they had measured the hole and the shaft and showing the marks on the stick to prove their assertions.

Seeing that they could not convince Mr. R., the measurements were renewed, thinking they might have made a mistake; satisfying themselves on this point they returned to the attack. To all their vociferations he calmly said he guessed it would be all right. Mr. R's method of boring out the hole was to take a piece of hard wood, say 3 feet long, and cut one end down to fit the eye in the wheel; a shoulder was then formed and the stick was cut to the diameter of the shaft and in length a little longer than the depth of the eye in the wheel. At the shoulder formed by the two diameters a ½" square mortise was cut through the wood bar.

The blacksmith on the estate forged a cutter which Mr. R. tempered and ground to cut on both ends. This was inserted in the mortise. Two grooves were cut in the wood bar for the chips to fall out.

The square end of the wood bar was then put in a vise, the bar standing vertically. The wheel was raised and lowered upon the smaller diameter of the wood bar, which came through the hole and served as a guide. Two or three of the peones turned the wheel around on the bar. The weight of the wheel served as a feed and the result was a hole that fitted the shaft.

The boss carpenter begged for that cutter, as he wanted to make a chisel out of it, on account of its rare and wonderous powers in being able to cut iron.

C. A. CALVERT.

A Word of Appreciation.

EDITOR SCIENTIFIC MACHINIST:

I wish to thank Mr. Volney W. Mason for his suggestion on cooling hot bearings, in the Questions and Answers column of your last issue. I tried it the very day I received the paper and it did work very satisfactorily D. C. BUCK.

AMATEUR AND APPRENTICE—IV.

BY EDWIN WOODWARD.

When a good thing in the line of tools or appliances is brought to notice it is worth while to study its merits, and if useful to secure it, but at the same time it is not desirable to be at the mercy of the tool maker or vender whenever a new piece of work seems to require a special tool to do it justice. If sometimes obliged to resort to a makeshift the outcome of it is usually quite encouraging. It makes the learner feel more independent and confident, and confidence, intelligence and zeal are the inevitable forerunners of ability. This being so, while it is desirable to possess all the tools necessary for speedy and accurate work, the want of them is not infrequently a blessing in disguise. The main point is not to call for a special aid for every dilemma. Grasp the general detail and make yourself the master of it. The handy man knows how to use a good tool, but can make any one serve in the absence of a better.

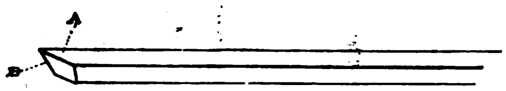
Fig 18.

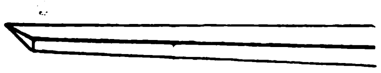
Fig. 19

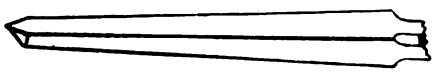
Fig 20.

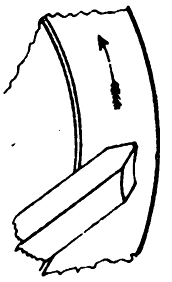
Fig 21.

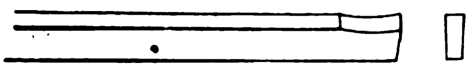
Fig. 22

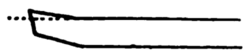
Fig. 23

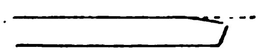
Fig. 24

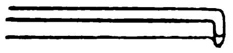
Fig. 26

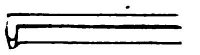
Fig 25

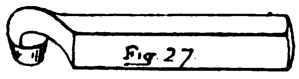
Fig. 27

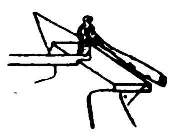
Fig. 28.

For metal turning upon the hand rest beside the tools 14 and 16, for plain external turning figures 18, 19, 20 and 21 are needed. The square graver—figure 18—is made of suitable stock and the cutting edges made by grinding at an angle of about 40°, its extreme point being one of the corners of the tool. It will be observed that either edge, A or B, when turned up will be a cutting edge, and is equally available as a right or left hand tool. By the terms "right" or "left" is meant that to whichever hand the cutting edge faces the tool—left hand tool cutting to the left—right hand to the right. A similar tool, figure 19, is made of triangular steel and is especially useful in sharp corners—its shape giving plenty of clearance, often needed and frequently wanting in the square graver. The point tool, figure 20, is made of both triangular and square steel. The angle of the point is left to the choice of the workman, but the cutting edges should be ground straight and this is accomplished by holding the tool transversely to the stone in grinding, as figure 21 indicates. This position makes the tool below the edge concave and thus facilitates the use of the oil stone in sharpening. In the figure the stone is turning with the top side from the operator. Many people choose the opposite side, undoubtedly for reasons of their own—the only valid reason supporting the practice being the fact that no wire edge is formed in grinding with the stone running this way. Many reasons forbid it. If the stone is large and run by power, to grind with the stone running to the operator is dangerous. The momentum stored up in the rapidly moving mass is not readily checked, and if the tool gouge or gets caught it will come down with vicious force against the rest, and the workman is fortunate, indeed, if he gets off with a blister or bruise in place of a finger cut off or a broken hand or head. That the other is the correct side is generally conceded. While it has many advantages it has no serious defects. The tool cannot gouge, and if it should cling to the stone, as it sometimes does, it will not grind the edge off, as does the other. A much more accurate bevel may be so ground. By placing the heel of the tool first in contact with the stone, then by raising the outer end up till the angle fits the face, its presence may be readily detected with no risk of injuring the edge. In using an emery wheel the positions should be reversed and the wheel run to grind. The high speed of this grinder renders gouging almost an impossibility. Then, too, if the point of the tool is held from you the danger of burning the tool is very great. It not only becomes hot from parting with its own metal, but every spark from another portion passing under helps to augment it, and the sparks render it impossible to see with certainty the edge. It is well to have a tank attached to the frame of the grinder in which to dip the tool to prevent overheating. Figure 22 is a tool that is used in making grooves or in cutting off. It is used principally on metals and should have clearance on the side as well as in front, but to a limited degree all round. It is not suited to soft woods, and for soft metals there should not be any top rake, as indicated by the curve in the top of the tool. Rake as understood in lathe cutting tools is that departure from a straight line with the body of the tool given by the angle of its cutting edge, and is termed "positive" and "negative," rake, respectively, as the angle inclines above or below, and is illustrated by figures 23 and 24, in which A is a positive rake and B a negative rake. But in speaking of the rake of a tool without any designation, positive is always understood, while for the opposite "negative rake" is always stated. For brass and similar compositions a tool with negative rake is used—with this there is no tendency to gouge. In hand turning tools but a limited amount of rake can be given, as the usual curve and sweep of the tool throws the point too far from the fulcrum, and the sharp point takes a deeper hold in the metal than there is ability to control, and consequently hand turning tools are usually designed more on the principle of scrapers. Such tools as are given much rake are mostly provided with a heel to project over the rest and receive the thrust, and longer handles are provided to serve as levers to retain a mastery of them in case they should—as they usually do—try to get away. They are a difficult tool to use and not at all satisfactory to the beginner, but an adept can with them remove metal surprisingly rapid.

The tools so far shown have the important advantage of being used with equal facility either to the right or left, as all work has been outside, but for inside work tools to suit are necessary. In boring out a pulley or trueing up any hole in work fastened to the face plate a tool similar to figure 25 is used. It is made the same as the round nosed tool, having a great deal of clearance at the point. About ¼" of the point is bent at right angles to the left, and is called the left hand inside tool. Another tool, the exact counterpart of the first, with the point turned to the right, is the right hand inside tool—figure 26. The point should not extend out much to the side, as it is difficult to keep from turning in the grasp. In former times turning lathes seldom had a carriage—by which name the sliding portion of the modern lathe, to which the turning tools are secured, is designated, and the difficulty of turning straight and facing up true was correspondingly great. To obviate this in a measure some happy genius devised what is termed the slide rest. It consists essentially of two parts, one mounted upon the other at right angles. Each part is provided with a slide and by turning a screw handle in either motion parallel to or across the lathe bed is obtained. Upon the upper or cross slide is the tool post—the turning tools are screwed fast in this—and the whole attach-t is secured to the lathe bed by same screw or lever that fastens hand rest. This requires an gether different set of tools, and vood turning one of the most tive is figure 27. Tools for the rest are made of rectangular steel, the width of which is e its thickness. This tool is y made by hammering down the edge of the anvil, as in e 28, a short length of the , to half its width; then, by al- ately hammering side and edge, hickness is reduced and width tained, till the blade is of suf- it length and thinness to bend the horn of the anvil to its imate shape. If due care has exercised in forging, every ion of the circle will have suf- it clearance. If, upon bending, is found not to be the case, it be corrected by slipping the heated, upon the horn of the , edge first, and drawing it out ner with the hammer.

ELATION OF A FOREMAN TO HIS MEN.

ie relation a foreman should to his men is a subject full of est to all who are placed in ge of others as well as those ating under them. The im- sion prevails that a foreman's es consist largely in the execu- of his plans, carrying out the 's of his managers and filling a of autocratic position above e placed in his charge, main- a gulf between them across h none shall venture by becom- too intimate, and keep his men onstant fear of the awful con- ences of breaking down the ier that exist between them. , the subject properly consid- , is a deep one, and one that ld not be lightly glanced over passed by with a comment . The fact that a scarcity ex- of good foremen and the lack of petent men qualified to fill fore- 's positions is shown by the ad- isements in the papers and the ral complaining heard on all ; the demand is for men of in- gence, character and reputation ability, who are honest and r. The character of a foreman is thoroughly qualified and can be designated by the word d" may be divided into many livisions. He must possess in relations to his men, and em- ers also, a composite character, ble of surmounting the varied ulties ever coming up in the routine of work. His educa- and experience should enable to grasp the character and e of the business in his charge, ould be able to concentrate all hought on the work in hand ook after the details with care, and certainty; he should be taking in the extreme and such a degree of affection for ork as will inspire him to look every minor consideration; he have patience, have a quiet determined manner in giving instructions, and above all s, possess the faculty of cul- ing the confidence and esteem s men, as on this alone may, aps, rest his entire ability to ed. He should at all times en- age new and original ideas g his men, as there is no one the average man is as jealous his idea, and when suggested to the foreman and then carelessly cast aside by him, it is sure to lead to diminished respect for rules of shop management and a lessening of that interest every man must have in his work if he is to succeed. It should be the policy of a foreman to encourage originality on the part of his workmen, as it leads to thought and study, and if he finds it advisable to reject their suggestions, let him do so pleasantly. He should allow any approach towards personal familiarity with his men in shop hours and while he must maintain a measure of dignity, it must not be too marked. How many of us have keenly felt the cutting manner of the proud and disdainful foreman who "knew it all?" who cared nothing for other's ideas and never used them, being satisfied with his own superior knowledge, and gave no thanks for any suggestions, and how many of us have done work repugnant to our mechanical sense, yet compelled by a "know it all" foreman, who was so puffed with his own conceit as to forget that a workman will often see a "short cut" which a busy foreman will overlook. No foreman is obliged to use any other than gentlemanly and reasonable means to arrive at the maximum productiveness of his men, and nothing is gained by the use of coercion, force and profanity to grind work out of his men. It is not necessary, it is a slur and a satire on the intelligence of our American mechanics to do so. The solution of the problem of how to succeed is more apt to be found in kind, proper treatment of each man, contentment in his place and a knowledge that the foreman relies on his manliness, honor and ambition to promote the best interests of his employers and has a due regard for short-comings, will go a long way towards adding to any man's productiveness.

Few foremen are found who are sufficiently explicit in giving explanations in a full and painstaking manner; too many say once what they want and leave much (not told) to be guessed at by the judgment and ingenuity of the workman, who, perhaps, but partially understands the work in hand; the painstaker will tell and tell again, if necessary, and his man, if not sufficiently sure, will not be afraid to ask questions. No foreman should have his favorite to whom all the best work goes; the bane of his life will be that favorite, who will engender malice, hatred and create disturbance by his actions, his independence in the shop and his assumption of authority at all times; all men should be treated alike if the best results can be expected.

Then there is the apprentice. This youthful operator should have his mind so molded by constant attention through his foreman as to become ultimately a capable and pushing mechanic, and the policy of every foreman ought to be to inculcate good ideas of the craft into their minds by patience, explanation and example, to enable them to become useful members of the trade, and by example, to instill into their minds the necessity of certain things, that they may become successful mechanics. Managers pursuing the plan of keeping their apprentices up to the standard, and when their apprenticeship is over, to hold them as mechanics and workmen, soon gather around them capable men, well acquainted with the peculiarities of the place and work, and trusty workmen who will carry to success any and all projects entered upon by the managers and entrusted to them for execution. But the foreman whose short ways, cutting speech and general carelessness of the outcome of the apprentice, as shown by his indifference to them, is going to prove himself a poor man for the position, in the long run. The cordiality, frankness and congeniality of a foreman has much to do with his success and his personality, magnetism and attachment to his men, will aid in securing the co-operation of the most stubborn employees. No man will hinder a foreman whose aim is to forward the work by systematically planning, managing and collecting the fag ends of a piece of work, that the workmen may intelligently understand what is wanted of him and who, when approaching a workman, knows just what to do to gain his co-operation pleasantly, cheerfully and completely. The requirements of a foreman toproperlyhandle the wide range of characters found scattered through an establishment and carry the work forward in a way to keep everybody good humoredly up to his fullest pitch and at the same time secure a profit to his employers are trying, and the required stock of ability is hard to find, but there are, without doubt, plenty of men capable to hold responsible positions and who need the chance only. Every man who rises comes from the ranks, and every foreman was once a journeyman and once an apprentice. Too much respect for all these things cannot be given, and the establishment of a perfect unity, cooperation, and mutual exchange of courtesies in the shop will be productive of the greatest good for the greatest number.—[The Foundry.

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RAILROAD MOTIVE POWER—V.

The gentleman here demonstrates and strengthens his position by an elaborate array of algebraic formulae, which it is unnecessary, to my purpose, to reproduce in this article.

Continuing, he says: "In locomotive furnaces the main loss is sustained by the immense velocity in gases when the engine is under heavy strain. A nozzle that will give, under ordinary strain of the engine, very satisfactory results, will, under a heavy strain, tear out the fire or reduce the temperature in gases to a degree where ignition is impossible. This velocity may, to some extent, be reduced by giving a larger grate surface, but in locomotives this cannot be done beyond a certain limit without inconvenience and loss in other parts of the machinery. A locomotive under 9,600 pounds strain—even if the influx were highly regulated—would still have a velocity in gases equal to 72 feet per second, or that of a storm. This is mainly owing to the small available grate surface, which forces the current to accept a high velocity to fill the vacuum made in a given time.

"Partly this may be avoided by hollow stay bolts or tubes, but while this arrangement is beneficial for the above mentioned purpose, it lays us open to an evil almost as bad—that of receiving at times too much oxygen; we may avoid this by obstructing the current by means of brick arches, deflectors, etc., which create a recoil of the current and increase of friction, which, reacting upon the grate surface, will lessen the influx of air and keep the air gases in contact for a longer period, thereby producing those effects needed." Now, according to the foregoing general summing up, the coming "smoke consumer" must produce results which may be condensed into the following summary:

1. The difference in pounds between the steam exhausted and the air inhaled ought always to be as 2 is to 3.
2. The bulk of the fuel on the grate must always be in proportion to the fuel consumed per second.
3. The grate surface ought to be as large as possible to prevent a great velocity of current.
4. The exit of gases from combustion should be retarded to gain time, i. e., to prolong the contact between the oxygen and gases under a very high temperature.
5. Keep in mind that too much draft is as injurious as not enough.

I notice that one of our oldest and longest trunk lines has abandoned the use of the brick arch in toto. In conversation with an official of the road he informed me that, after having given the brick arch a thorough trial, his company had failed to note any good results from its use, and consequently had abandoned it as a measure of economy. This company had humored the brick arch in every possible way. They had put it in their different classes of engines, tried it with different kinds of fuel, put it in charge of their best engineers, had set it up, then down, out, then in, had tried two, four, then six bricks, had set it at one angle and then at another, but all to no good results. Nothing in it but loss. I did not learn how many engines were equipped in this manner, but it is safe to presume that three or four years' trial of the device, in their different classes of engines, must have entailed a pretty heavy expense for labor and material, to say nothing about the injury to side sheets in the way of holes for angle irons.

It seems very absurd to see a road condemning and throwing brick arches out of their fire boxes, and its next neighbor putting them in and lauding them in unmeasured terms as the ne plus ultra of fuel savers.

It appears the Allen valve has given offense in some manner. I notice that certain master mechanics are throwing it out of their steam chests and replacing it by the old style D valve.

This practice appears to me to be retrogression with a vengeance. Will those discarding the Allen valve kindly favor us with their reasons for doing so? I merely ask for information regarding its defects, if it has any. But, perhaps it is merely a whim, and without any well grounded reason to support it. It was always claimed that the Allen valve was a most excellent device for getting a good supply of steam behind the piston at the very moment that it stood most in need of it, and I scarcely believe that those who are now discarding it, can prove this claim to be unfounded. I have, at times, been highly amused at seeing a newly installed master mechanic fussing around to find something to tear down, that his predecessor has built up. And I have always noticed that the man who knew the least always tore down the most, and generally only to put the same things back again. The main valves are about the first things they tackle, and cease demolishing and changing things only when the man on the foot-board makes a vigorous kick.

They next find fault with the number plates as being either too large or too small. Then they discover some error in the design of the blow-off cock. After all these grave errors are rectified, the boss painter's attention is called to the figures and striping on the sandbox, as not being in accordance with the latest improvements in the painter's art. And again the oil cans are not standard according to his ideas, and so on for quality and quantity. This is no fancy sketch. This particular brand of master mechanic existed a few years back, and may be in the flesh yet for all I know to the contrary. He also is considerable of a Martinet; feels his oats, as it were, and tries to impress all those around him with a high sense of his importance. He is obsequious to his superiors and imperious to his subordinates. He knows all about a locomotive too; and more particularly is he impressed with this idea if he has not served an apprenticeship in a machine shop, never built a locomotive, or helped to repair one. He is a good talker, dresses well, and possesses a superabundance of gall. Not many years ago he was a cornfield canary, but now he is a full fledged master mechanic. Had friends at court, of course. He never learned anything from anybody about an engine, had no need to, as his knowledge of a locomotive and he were born together at the same time. He looks grave and dignified, and like Atlas of old, he would appear to have a mighty load upon his shoulders. He either addresses a shop hand as though he were no better than a dog, or else, manifests his will by an imperial look and a majestic wave of the hand. Fortunately this sort of master mechanic is very largely in the minority. D.

The famous jubilee shot fired from a 22-ton gun in Queen Victoria's jubilee year, to ascertain how far a shot could be carried, remained in the air 69½ seconds, and the highest point reached in its flight of 12 miles was 17,000 feet.

The War Department is negotiating with the Armstrong Company, of Elswick, England, for the acquisition of designs of a new rapid-firing gun, which is said to be 20 per cent. more rapid in action than any other gun. It is also contemplated to secure the right to manufacture these guns in the United States.

Senator McMillan and son, of Detroit, Mich., have purchased the entire interests of the Mutual Gas Company, of that city, for $1,500,000.

MACHINE-SHOP NOTES.

The getting of commercial results in the manufacture of machinery is after all the criterion of success in the present stage of progress, and it is easier, comparatively, to devise a mechanical success than it is to market one and make it pay dividends. The keynote to successful manufacture is the making of the articles cheaply and well, for if they are not made cheaply they cannot be made to pay, and if they are not made well they cannot be sold steadily or have a lasting demand. Hence a man who is capable of economically duplicating a good device has more value to the producer, as well as to the consumer, than the inventor has. The grand secret of manufacture is, first, to do it,—not to begin, not to get ready, but to do it. Get the material in, and get the work out. Do not permit a single cost or excuse to stand in the way of this result. The second secret is to make each succeeding lot of the output cheaper and better than the last. In this connection, because every concern must do its business on the principle that each article is to be sold at a stated price, it follows that each must cost a fixed price, and this idea prescribes that piece-work shall be the sole method of paying for the manufacture. And there are no paying industries in this country that do not employ piece-workers as a rule. There may be obscure or belated factories doing day's-work manufacture, but they either do not pay their owners as they should, or the output costs the buyers more than it should. The third point is to push the work by constant unremitting enery and vigilance. Go to the assembling-room and insist on larger production. Listen to the complaints there made of lack of material from the other departments and of suitable help. Then go to the other rooms and demand that they get out more work, and then listen to the complaints made of inferior castings or other stock and of insufficient tools and room. Listen to all these complaints and investigate them for facts. Supply the deficiences and push harder every day. Herein is the secret of economical manufacture.

⁂

If a person, when he wants a machine-tool, could wait six months for it, until he could examine all that are made of the kind he desires, he would then be able to select the best, if his judgement could be trusted to tell what is best after so prolonged a siege. Now most tools are selected quickly, because they are needed at once, and what appears to be the best is taken and set to work. Hence many poor tools are got where better ones should and would be taken if more time for investigation were had. There are of course establishments where the most suitable tools are selected and recommended by experts, and a few of these deserve all praise for candor and fairness, but many of them do not push forward the best tools, but advocate instead those most profitable to them as dealers, and if a buyer falls into the hands of such he may suffer for it. There seems to be a need of a more perfect means by which buyers can be made to know the comparative capacities and values of machine tools, so that when they need such tools they may not be in any great doubt as to that which is nearest to their wants.

⁂

There is one thing that Blunt has learned well and by many experiences,—namely, that the man who buys for himself saves considerable money. So he usually did all that himself. In his absence lately it was not distinctly understood who should do this; so Charley Gaul permitted the commercial travelers to entertain him with descriptions of their marvelous wares. One day a particularly fine talker got him interested in a new oil that was a lubricant of great value, if one tenth of the claims were true. He ordered a barrel of it and refused an invitation to dinner. This invitation did not look right, so he called halt.

"Say, I'll call the manager. He ought to know all about oils; he's a college man."

"All right. I can stand the college fellows, but I despise the shop men."

"Mr. DeGree, this gentleman has a new oil for lubricating fine shop tools. It is used and recommended by the Universal Electric Co., the Mogul Engineering Co., and—Show him those letters, Mr. Lingey."

The letters were all that the most exacting person could desire, and more. DeGree had never heard of so good an oil as they described.

"We have enough oil to last until Mr. Blunt returns," said DeGree, "but you may send us one gallon for trial, that we may be able to report upon it when he comes."

"This oil, sir," said Lingey with some impressiveness, "has passed the experimental stage, and we do not send out less than one barrel. If these letters do not satisfy any one as to what that oil can do, nothing in the world will."

"If we needed oil it would be different, but as it is, we will take your testimonials and report to Mr. Blunt on that."

"That oil is selling today for 47 cents. In one month it will likely be 60 cents."

"We will not buy today."

"Good morning."

When Blunt returned, DeGree showed the testimonials and told his chief about the oil man.

"These letters aren't worth the paper they're printed on. Every one of them is written by a man who does not know oil from antimony. I don't know what the machine business is coming to. Generally when a big company is formed, a favorite or a relative of some member is made buyer, and the drummer who can talk the smoothest sells his goods. I tell you, sir, if there is one place more than another in a large concern that requires an honest, shrewd, experienced, practical man to make money in, it is the buyer's. There is Charley Gaul, now; he could sell a bill of goods to Daniel Dancer at list-price, but he is just soft enough to bite at the clumsiest kind of a bait himself. I'm glad you got away from that fellow."

⁂

Independent of the great technical value to engineers of a knowledge of geometry, this study h another, and I believe the greate value—of discipline in the necessi to prove and demonstrate a pro lem so far that there is no pla for doubt in the answer. T method of the geometer in desi is the only safe one, and that is know absolutely just what ea member of a machine can do, fro the most searching analysis of possible to make before that e ment is accepted. The practi man of wide experience will kn the behavior of many kinds of mo ment which he has used before, a certain knowledge, and he w not need to demonstrate such accept them or to know their limi tion. But such as he does n thoroughly know by practice should demonstrate before usi The effects of every movement m be found on a sheet of paper grap ically with the dividers, and w the law that motion and power a inversely equivalent to each oth constantly in view, the precise r sult of every movement may found very simply. The wri generally demonstrates a mo ment, however, by constructing from pasteboard, using comm pins for fulcrums and journa This method does not take so lo and no errors of numbers can cre in. Besides, there is satisfacti and safety in seeing a thing me that can come from no other k of demonstration.

⁂

The directions in which mallea metal flows under pressure or bl may well be made the subject of tended observation by every en neer. If struck on top by a hammer or ram, the tendency not so much to be driven dee into a design on a lower die as it to flow sidewise, unless the desi is so proportioned and its reces so distributed over the lower s as to demand and receive about much metal in one place as in other, in which case there will no pronounced side flow. Thu design composed of radial or volute corrugations will be fil perfectly, while a deep annu pattern may fill and then be shea off. I have known a design to nea fill on the first blow, and on second blow to be scarcely dist guishable in consequence of metal flowing away and removi the first impression from its po tion within the die. In roughi out or forging stock to be dropp in a press, it should be made to b tom on the dies first and before sides are filled if practicable; otherwise the internal outline c ners will be filled only with gr difficulty. If the roughed-out st bears on the cheeks of the dies, a if it does not touch the lower pa or nearly touch them, the blo will at once form a very refracto fin and expend its force in co pressing that fin between the fa of the dies. Where two or mo blows are to be struck, the first should make a blank the verti cross section of which will be p portionately high and narrow every detail; then the last co pression will fill the die perfectly utilizing the flow instead of opp ing it. This is the most effecti treatment for either metals or m the best effects come of directi their peculiarities toward desi results rather than of forcing them to fit our peculiarities.

* * *

A friend told me that he had found brass at a certain temperature capable of being swaged and bent much more advantageously than when cold. By a question I ascertained that what he called brass was a composition largely of zinc, with perhaps a trace of lead. By another question I found that he was not aware that cast zinc is malleable within a limited range of temperatures; that it is brittle above as well as below that range; and that his temperature for bending his brass was well within that range. Now this friend had experimented exhaustively on these temperatures, and found that which gave him the best results in bending, but if he had thought to read what has been written of the traits of the constituents of his alloy, he would very likely have had no experimenting to do. Thus we do not think about what has been done, but go ahead and rediscover—or fail to discover—truths that are of easy access to every one. Often we do not recognize an old problem in a new guise. Oftener we do not think about it at all, but dive into it unmindful of the fact that much of the data of what is knowable of material things have been discovered and are contained in a small number of books.

* * *

Whatever form or character the collars that locate a shaft or a spindle may take, they should embrace only one and the same journal-box. If they do not, then when that shaft or spindle elongates by the heat of friction, these collars, if they are fitted between two journal-boxes, will bind and cut, or, if they embrace two boxes distant from each other, they will open when extended by heat. When they are on each end of the same journal-box, however, the shaft or spindle and that box will each expand and contract about equally and will neither bind nor shake.

* * *

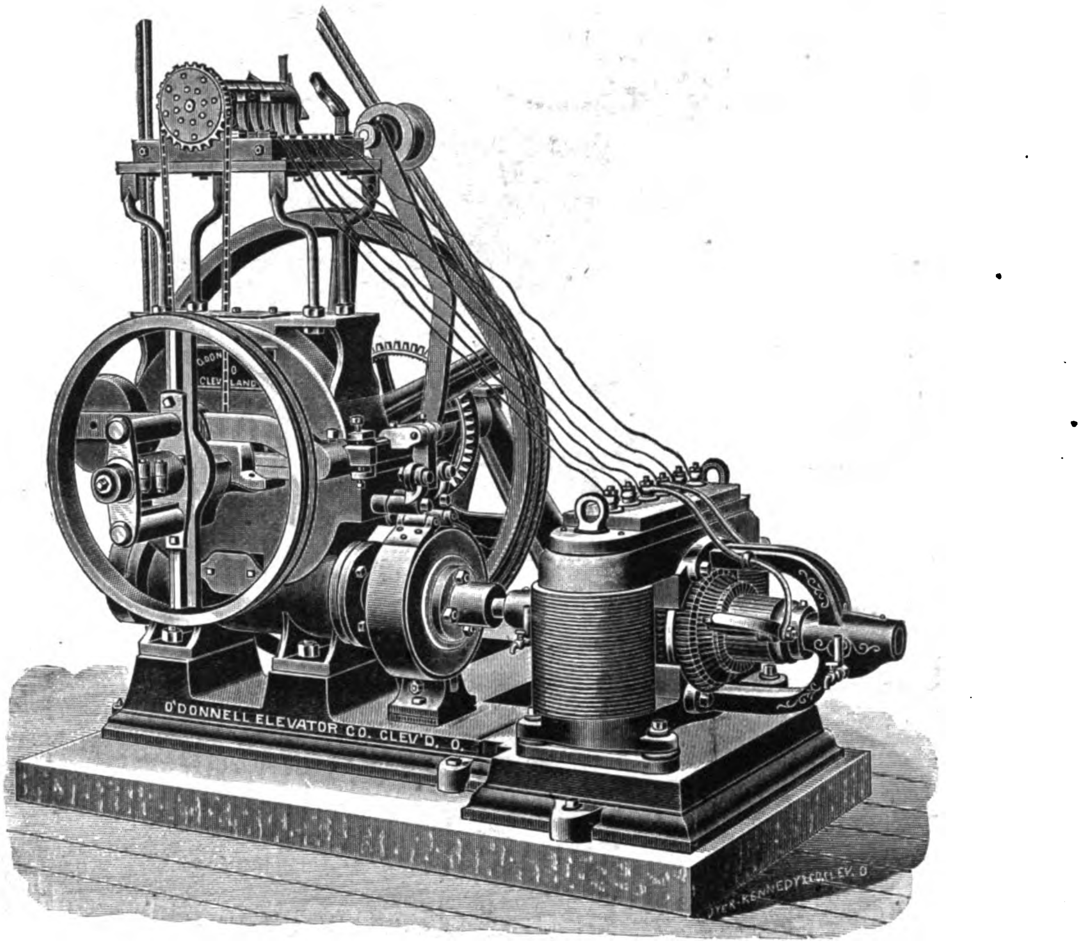
The ability to design a drill jig that will work perfectly and quickly, or a milling fixture that can be depended on to support effectively the piece being operated on, is of more money value to a man or to any machine-shop today than a knowledge of the integral calculus, and men who are being prepared for mechanical engineers ought to know it. The indications are strong that this will continue to be a fact and be more pronounced as long as machine-shops are run for the profit there is in them.

* * *

Ordinarily it is best to remove all the material to be cut from surfaces on cast iron pieces as a first operation. The reason for this is that, when the metal is taken from such surfaces, the internal strains are partly relieved, and the piece will change in shape. When, therefore, holes having positive relations to each other and to other working points have not been made after the removal of masses or extended areas of metal, these holes will be found to have changed in their relations to each other after such removal in almost all such cases.—[A. D. Pentz in Engineering Magazine.

NEW ELECTRIC ELEVATOR ENGINE.

M. J. O'Donnell & Co., of Cleveland, builders of elevators, have put on the market recently an electrical elevator engine, of which the accompanying illustration gives a good view. Several of their elevators, with this electric propulsion, are already in use, and with satisfactory results. The engine consists of a heavy cast iron bed plate, firmly bolted to a stone foundation. The motor is bolted to this bed plate, also the housing that contains the worm and gear and bearings for worm gear shaft. On the gear shaft which projects through casing is a sheave which is turned a double V groove, this preventing any slipping of the hoisting cables. One end of the cables is fastened to the counter-balance weight and the other to the platform toggle. The brake is operated by a cam on the shifter-sheave, and attached to this sheave shaft is a sprocket wheel which revolves the arm one-third of a revolution to make the full electric contact on the switch. The motor part of this elevator is designed and manufactured by the Keystone Electric Co. For further information, sectional view or prices, address M. J. O'Donnell Elevator Co., Cleveland, O., and if you mention this paper they will understand more readily what you refer to.



NEW ELECTRIC ELEVATOR ENGINE.

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DOES IT PAY TO RE-CUT FILES?

The following paper was read before the American Society of Mechanical Engineers, at its annual meeting in New York Nov. 29 to Dec. 2, in answer to Topical Query 114, by H. Binsse:

I have given attention to this question for a few years past, and I am convinced by my experience that it pays well to have files re-cut, provided that an economical grade of file be bought in the beginning. Economy, to be consistent, must commence by purchasing that file which yields the largest return for the outlay, and it does pay to re-cut this grade of file, but it is a waste of money, in my experience, to buy cheap, common files, and this is the grade which does not stand re-cutting.

I can make my meaning clearer by relating the practical illustration which opened my eyes to the difference in the efficiency of files. A little, flat block of tempered steel had been worn slightly concave and was sent to me to be filed flat. We had promised to finish it by the following evening. The work was begun at 7 in the morning and when I came to my office my foreman reported that the first file, a new one, had given out. A second file followed, and before noon my foreman again reported that no progress had been made and that the third file was dull. All three files were of the same size and cut, but of different well-known makes.

At noon time a high priced file of a celebrated make was procured, and the workman began to use it at 1 o'clock. The job was finished before 6, and this file was in first rate condition and was used for long afterward.

This experience led me to buy a few files, paying for them about double the price I had been used to, and I found that, besides performing from 20 to 30 per cent. more work in a time unit, they outlasted from two to three files. It appeared clear to me that this increased efficiency of the man's labor would warrant the use of the dearer file, leaving the other file as clear profit.

A good file must be made of good steel; it must be cut carefully with a sharp chisel, and it must be carefully hardened and tempered. Cheap files are made, necessarily, of cheap, common steel. A blunt chisel will cut more files than a correctly whetted, sharp chisel, for the sharp chisel gives out sooner, but the blunt chisel forces up the metal, injuring the steel and making a short, stubby tooth, with incorrect clearance angles. The steel has been weakened by the hammer-like blow and is in no condition for service. In addition, cheap files are made by unskilled, cheap labor, which does not know whether it is making good files or bad ones.

Finally, cheap files are tempered by methods which give a large product at the cost of quality; frequently the files are too soft, frequently the teeth are burnt, and often the surface is warped, so that it bears in spots only and not over the whole surface.

The chief argument advanced against re-cutting is that the low price of new files does not warrant it.

It is my belief that this grade of file is the dearest kind which you can buy. Of course, this cheap file will not stand re-cutting. I have brought here two files which cracked in hardening. You will notice that the teeth are still soft, although the steel was heated high enough to crack it.

Files made of good material may be re-cut twice, sometimes oftener, and they are the more adapted for this, as I have found that the high priced files are from 12 to 20 per cent. heavier than the others.

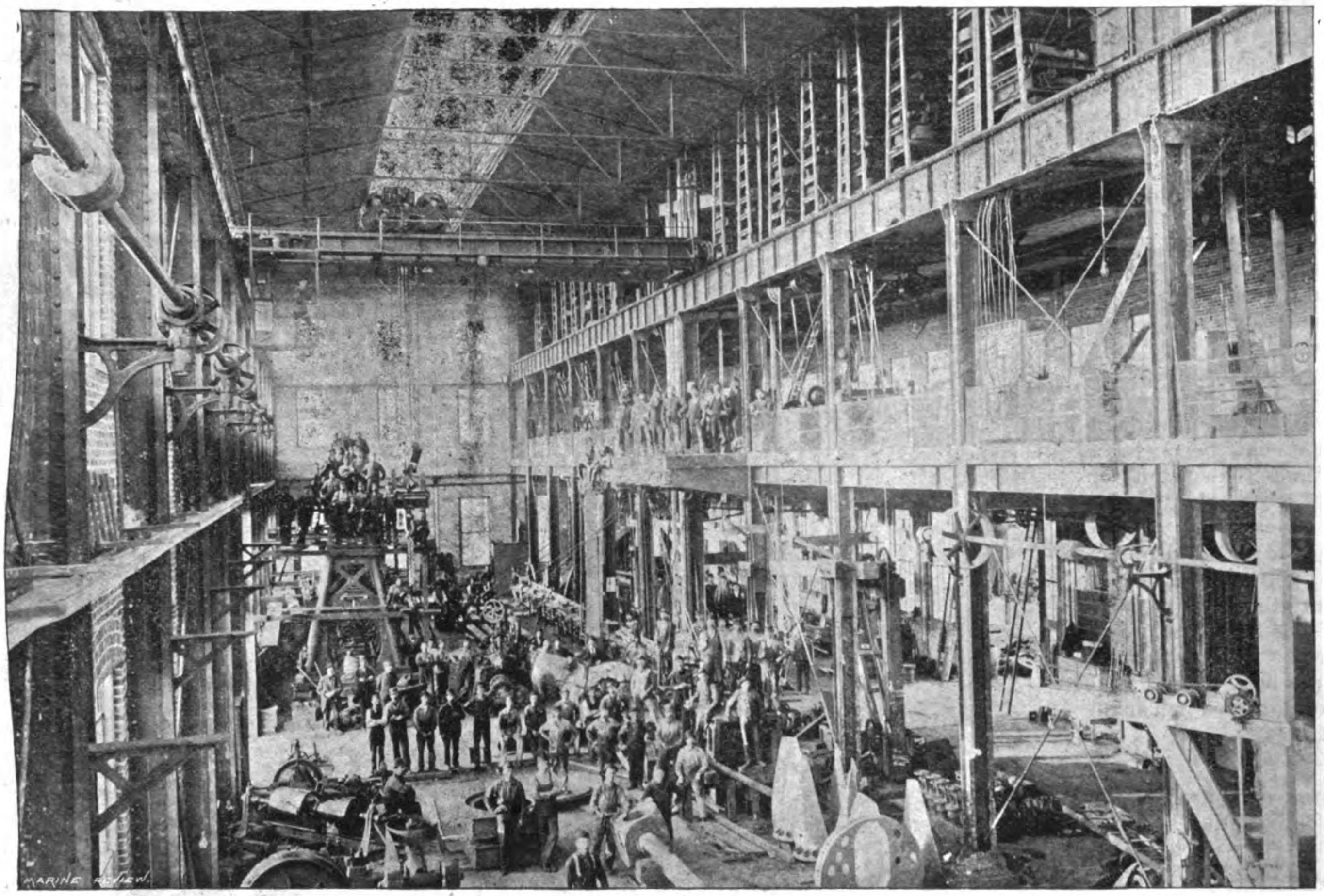
Files of excellent quality can be had at about 50 per cent. off the American list, and they cost about 35 per cent. off re-cutting list for re-cutting. I can find no important difference between the new and the re-cut file, and, at these prices, there is a saving of about 30 per cent. in favor of re-cutting.

◆

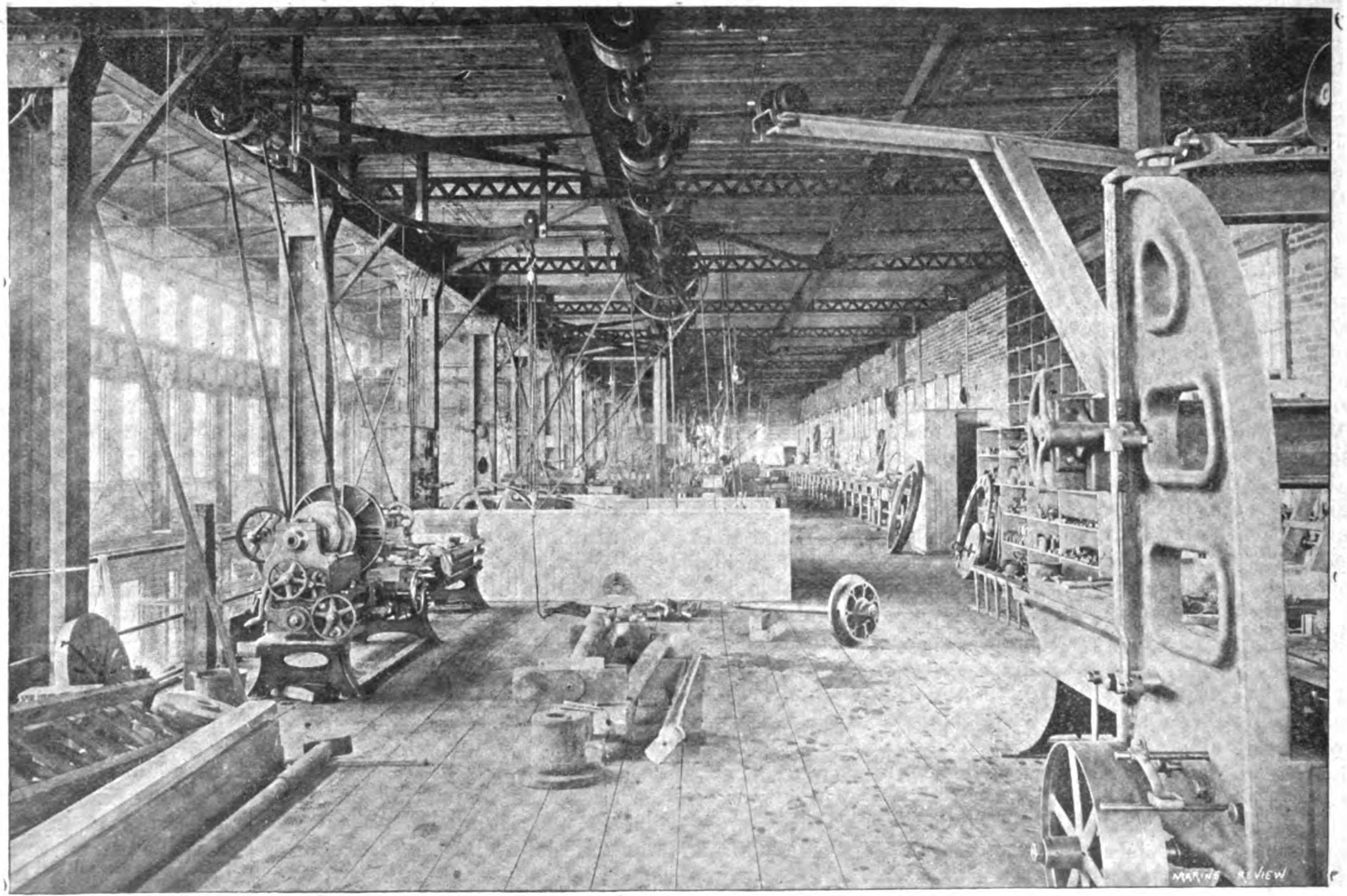
ACCORDING to the records of the mint, 19,570 dollars were coined in the year 1804. Of this number but eight are now known, and they are valued at from $500 to $2,000 each. What became of the remaining 19,562 is one of the greatest numismatical mysteries.

ENGINE SHOP FOR LAKE CONSTRUCTION.

The magnitude of marine construction for the Great Lakes is not appreciated by those who have not visited the lake region, seen the fleets pass up and down the Detroit and St. Clair rivers and inspected the yards where the 3,600 vessels and ships were built and the shops where the machinery for the 1,592 steamers was constructed. Those who have never seen one of these places will be interested in the illustrations on this page, showing the new engine shop of the Detroit Dry Dock Co. This was recently built for them by the Berlin Bridge Co., and is the most roomy and the best designed marine machine shop on the lakes. In fact there is no shop on the continent better equipped for this class of work.



INTERIOR VIEW OF ENGINE WORKS.



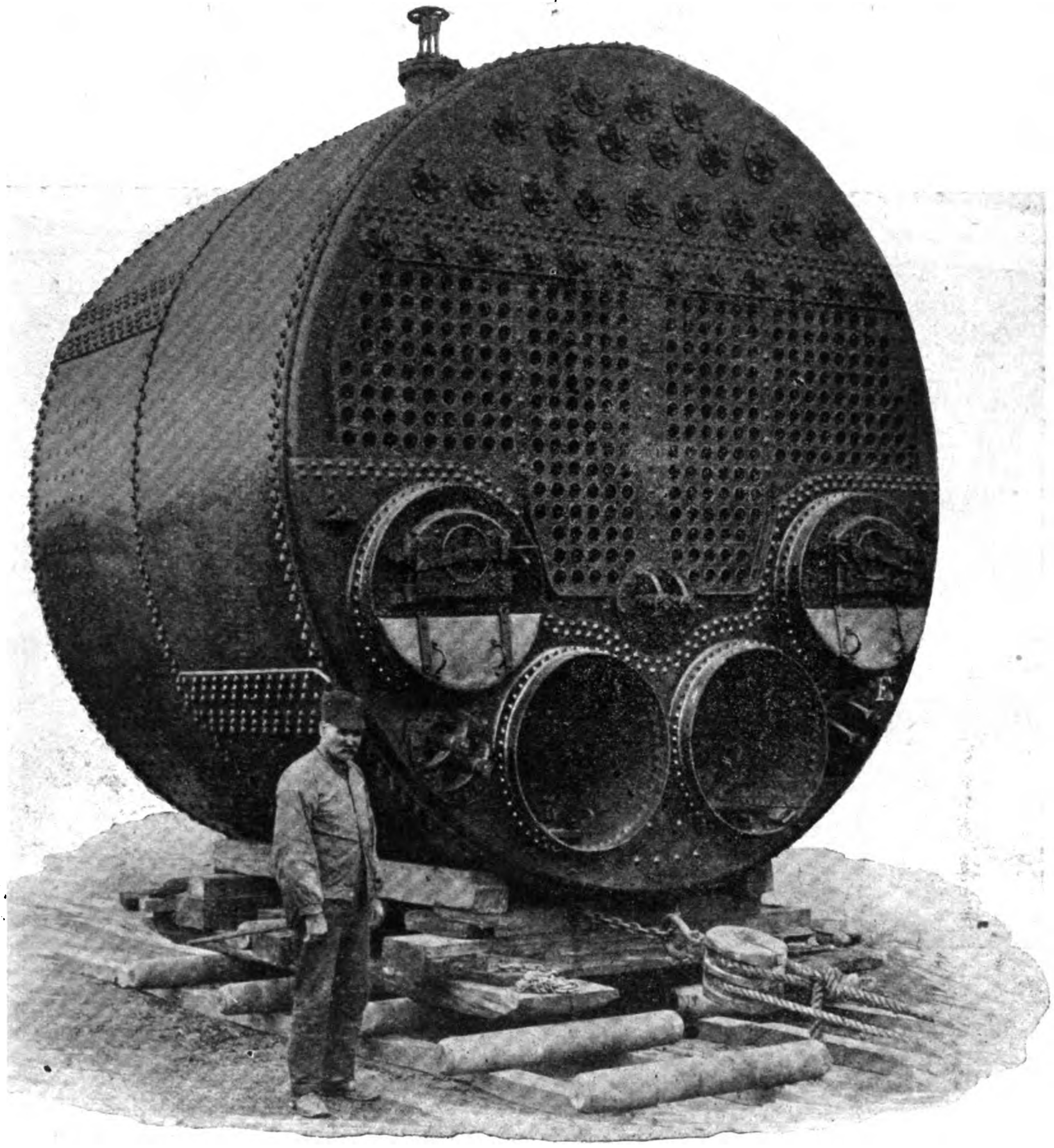
FIRST GALLERY IN ENGINE WORKS.

The construction is of steel and brick with fire-proof floors and roof. The entire building is 200 feet long, 66 feet wide and 50 feet in height. The main shop for the erection of engines and for heavy machinery runs the full length and height of the building and is 37 feet 3 inches in width. From this main floor space there is a lean-to 26 feet 6 inches in width, which also runs the full length of the building, and which is divided into three floors, the first, or ground floor, being used for power purposes and for heavy machinery, the second for light machinery and for bench work, and the third for the storage of patterns. An elevator affords ready access to all of these floors, or galleries, and there is an abundance of light and air from the fact that there are no partitions between them and the main shop space, while the facilities for the transmission of power and the handling of material by a large electric crane in the main shop are most complete.

One end of the main structure is reserved for the erection of machinery, and the space devoted to this purpose admits of four of the largest triple expansion engines being put up at one time. At the other end of this main portion of the building the large tools are so arranged that work from them can be readily transferred with the least possible difficulty by means of a 20

Shaw electric crane, which runs whole length of the building, l which can be applied to heavy rk in the galleries as well as in main shop. This crane has 37 t span and the space from the r to the crane hook is 36 feet. cale attached to the crane will gh any amount from a few ounces 20 tons, so that in accepting gings and other articles of out-e manufacture the company has own weights. Among the big ls in the main shop are the fol-ing: A planer capable of planing inches square in the clear; a 48 h double head planer; 120 inch ie, 24 feet between centers; wall ner, capacity 14x20 feet; a 96 h lathe; 30 inch stroke slotting chine; 18 inch stroke slotting chine; 36 inch lathe; 48 inch he; 60 inch boring mill; two radial ills and a vertical suspension ill. On the first gallery there e three small planers and seven all lathes of various sizes, two apers, three vertical drills and a nch 75 feet long for vice work. this floor is located also the ctric generator for the operation cranes and the electric light ant. The upper gallery, or the ird floor of the side structure, w devoted to the storage of pat-rns, etc., can be readily equipped th machinery when additional rk requires it, and a new build-g can be put up on the spacious emises of the company for stor-e purposes. That portion of the engine works not taken up by e new building has been utilized r the manufacture of patterns, for ore rooms and for offices for the remen of the different depart-ents of the engine and boiler rks.

This company launched last Saturday the Selwyn Eddy, one of the boilers of which is illustrated on this page. Each of these boilers is 14 feet and 10 inches in diameter with tubes 11 feet and 6 inches long.



ONE OF TWO BOILERS FOR STEAMER SELWYN EDDY.

BLACKSMITHING FOR ALL MECHANICS.

BY JOSEPH HILL.

A simple and practical method of scarfing steel for welding: Take the piece of steel whatever shape you have, make a common scarf, Fig. 1, then cut down with chisel and form a lock, Fig. 2, which you readily see prevents it from slipping. The other advantage is that you are sure of the heat being perfectly clean before lapping. That is one of the principle points to watch in welding steel. Take the steel when ready to weld, direct to the steam hammer and lap so that the projections raised on each piece with the chisel interlock. After trying it a few times, I think it will be found to be a rapid and practical way.

A preparation that will make the welding of all kinds of steel, especially tool steels or hard cast steels, comparatively easy: You are aware there are many recipes in the market and have tried several of them, alway anxious to learn of a better method; but you will find none so cheap and successful as this simple formula:—Burnt borax powdered fine, with one-tenth part of salammonica added. By burning the borax you absorb most of the moisture or water it contains and when you apply it to the heat, as you are about to weld, it will not form a flux until the steel is hot enough to weld. Experience has taught, or will teach you when applying the borax without burning it forms a flux, when the metal is only red hot, that is very likely to deceive in the heating of the steel, and we think the steel hotter than it really is, on account of the borax forming a flux so easily. But the burnt borax will act as a thermometer to you, by not forming a flux until the steel will unite. Experience of fifteen years teaches me that this is the best plan I have found so far; if there are better formulas, shall be pleased to learn of them through the Scientific Machinist.

Here are a few practical ideas about tools needed in a general blacksmith shop for rapidity, strength and accuracy combined. The most convenient forge for general work should be about 2 feet 9″ wide and 4 feet long, with rounded corners. Always work with what is termed a dry tuyer up to sizes of iron about 3½″ in diameter or about that solidity; you will find it enables you to heat about 15 to 20 per cent. more iron in a day, than can be done with a water tuyer iron. But above the sizes mentioned you gain time and it will be more convenient to use a water tuyer iron as the cooling of the fire on large work is not so effective as on a small fire, and the dry tuyer iron gets hot, causing the clinkers and dross to stick around the blast hole, thereby choking the blast, oftentimes when you require the most blast to bring the work to the desired heat.

An original method for melting heads or plugs in pipes, for instance, from 3″ diameter up to 10″ diameter: Numbers of these tubes are used in boiler works and especially the larger sizes are used in connection with ice making or refrigerator machinery. It is very simpie, practical and economical, as I will endeavor to show.

In the first place you require a heading tool, the thickness you wish the plug. The hole in it should be 3-16″ or ¼″ larger than the hole in the tube or pipe, with a slight taper allowing it to drop out freely, and it will also make it easier to place in the pipe. Then cut off pieces of round iron or old shafting, long enough to fill tool and form a small flange or head a little larger than the outside diameter of the pipe and about ⅜″ thick, Fig. 4. You can cut off several pieces with the steam hammer at the same heat. Then place them in the heading tool and they are headed with two or three blows each at the hammer, thereby wasting no material, as the most general way at present is to punch a round plug out of a bar or square piece which necessitates considerable waste. Since a square is fully ¼ heavier than a circle, you will readily see this method has great advantages over the present method used as I endeavor to point them out. First, the strength of weld, in the above described plug you find a head or flange which enables you to have an end weld as well as a side weld, but when using a plain plug,. Figs. 5 and 6, you simply have the side weld. Second, the headed or flange plug enables you to be much more rapid on welding and also keeps the end of the pipe perfectly square, when such is not the case with a plain plug, especially when you reach sizes from 7″ to 12″ diameter; nine times out of ten you get them out square ½ to ⅝ on the end(?) Why is the flange plug more rapid to weld than the flangless plug?—because you have to put the plain one into the hot pipe cold, allowing the shrinkage to hold it in position. You have a large piece of iron to heat when in the pipe. say 8″ or 10″ diameter by 1″ or 1¼″ which you cannot hurry too much for fear of burning the pipe, but the other way you can put your flange plug in the bottom of fire before the pipe is put into the fire; when the pipe is heated and ready for the plug, it is red or white hot, then place it in the pipe. It may be a shade slack, but what matter, the flange on the plug prevents it from entering too far in and when heating you have a hollow or top fire, as we term it, with a hole in the back, large enough to allow a piece 3″ diameter to enter that, when hot enough to weld, you can weld the end before removing it from the forge, with a bar of a rather large head on it, thereby ensuring safety of position, and also enabling you keep the end of the pipe perfectly square. Always weld your pipes in swedges that form a slight V-shape, Fig. 3, and always have a squeeze or pressure on the pipe, preventing the loosening of the weld.

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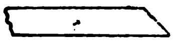

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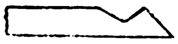

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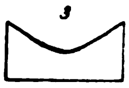

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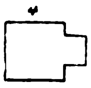

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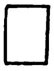


6

THE CARE OF SMALL SAWS.

Although much has been written upon the subject of saws, their care and management, yet most of these articles have reference to the large circulars used in the manufacture of lumber from the log, while the small saws used in the planing mill and sash and door factory, as well as all other woodworking concerns, seem to have but little attention. From the fact that so large a number of small saws are used in those factories, many of them by men of limited experience, and the importance of their being kept in good running order, a few hints upon this subject may be of interest to those who use them.

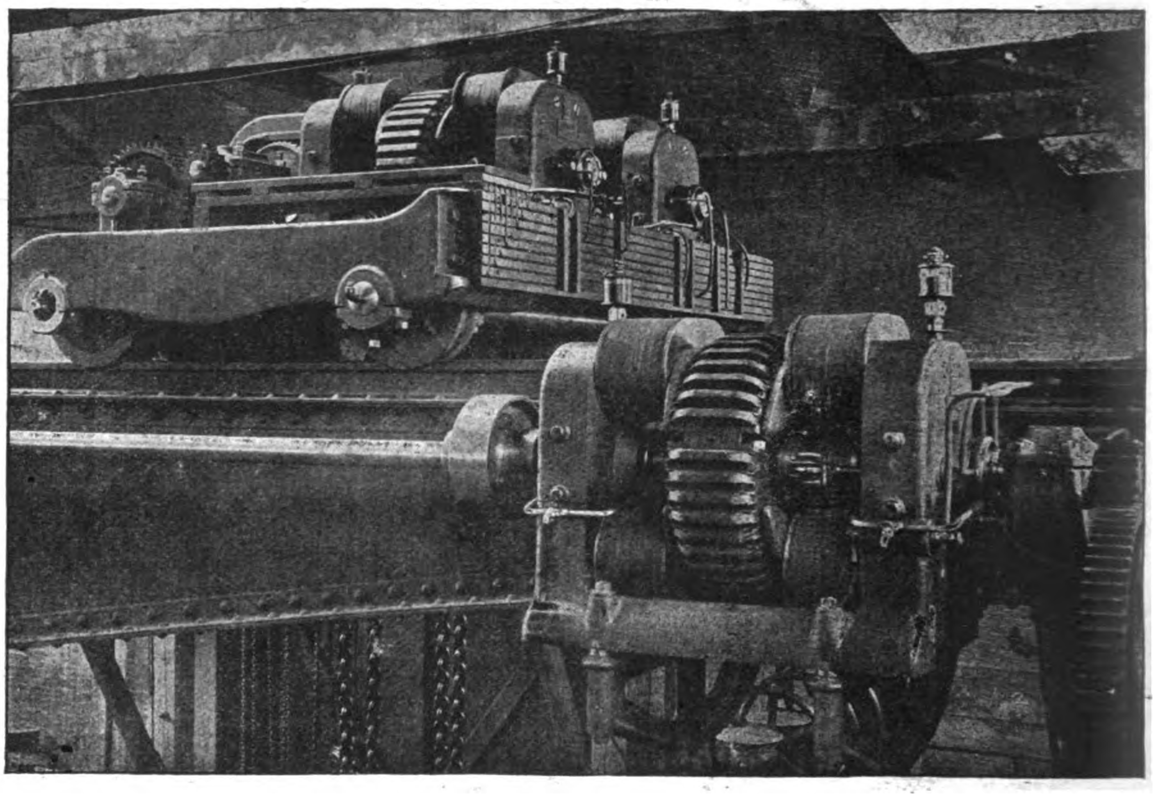
Because a saw is small in diameter, is no reason, says the American Exporter, why it should not have the same care as one larger. In looking over the saws in almost any mill of this kind, but comparatively few will be found without a blemish of some kind, most frequent of which is the blue spots upon the face caused by heating in this particular place. These spots, called by the sawyers "beauty spots," are caused by the heat generated by extra friction upon this particular place, the cause of which is not known to the user, whether he be an experienced sawyer or not. An experienced sawyer should be able to discover these causes in time to remove them before the saw becomes materially injured.

Under ordinary conditions where the plate is straight, as is the case with all new saws, there is no good reason why one part should become more heated in common use than another. But after a spot is thus formed and the plate is sprung, which may easily be detected by the straight edge, it will be found that in this particular spot it is bulged upon one side and hollow upon the other. That is, one side is stretched, while the opposite side is upset, and while it remains in that condition the rounding side will come in contact with the stuff and be subjected to extra friction, and the heating at this point will increase until the saw becomes so crooked that it cannot be used. If the plate were not permanently set as soon as the saw was stopped and the heat allowed to subside, it would return to its normal condition, but from the fact that it does not do so, it is evident that the particles of the steel are displaced, and before an attempt is made to use it again the fault should be corrected, and in such a manner as not to affect the whole plate. Some have recommended hammering upon the hollow side so as to stretch that side to correspond with the other, but this manner of proceeding would have the effect of making matters worse by changing the whole tension of the saw and necessitate hammering the whole surface in order to equalize it. If, however, it were pressed back without the use of the hammer the chances are that the same conditions by which it was bulged would be reversed without the heating, and while the concave side would be slightly stretched, the convex side would be upset in the same proportion and the normal condition of the plate would be restored, so that but little, if any, hammering would be required.

The most practical method is to force it back with a press. In the absence of a press a hard wood block, perfectly square and even upon the face, may be used as an anvil. The saw should be placed upon the block with the concave side next to it; then with another block sufficiently large to cover the convex side, a smart blow with a moderate sized hammer will, in ordinary cases, force it back to its normal condition without materially affecting the plate otherwise. Care should be taken in all cases that the work be properly performed and the straight edge should be frequently applied during the operation; otherwise it is liable to be bulged in the opposite direction, and in no case should the hammer be brought in direct contact with the plate. When the operation is completed, should the tension of the saw be slightly affected it should be taken to the anvil, when a few light blows with a small hammer applied in the right place will easily correct it. As it is said that one ounce of prevention is worth a pound of cure, if proper precautions are taken in the use of saws there will be no necessity for either bulging or "beauty spots." In the first place a saw should have sufficient set to prevent the plate from coming in forcible contact with the stuff, and when such is the case there will be no necessity for heating. Again, in lumber that is filled with pitch, small particles of it mixed with fine dust will often adhere to the plate. This is one cause of heating in this particular place when it is allowed to accumulate. Therefore it becomes necessary for the sawyer to watch his saws and keep them free from all such accumulations.

Imperfect set is sometimes the cause of heating by the saw running to one side, yet the danger from bulging is not so great, as the saw is usually heated about equal in all parts. Success in running small saws depends upon the following conditions: They should run true upon the arbor, they should be kept sharp with sufficient set to clear themselves, the guide should be in perfect alignment with the saw, and the lumber should not be fed to it any faster than it will cut and clear itself of sawdust. With these precautions much of the trouble may be avoided.

◆



NEW CRANE MOTOR.

NEW CRANE MOTORS.

Electric motors have revolutionized the crane business, and to-day the three-motor cranes (one motor for each motion) are in demand in preference to all other methods for any kind of work whatsoever. Some work even requires an extra motor for hoisting light loads where the main hoist is not rapid enough except for heavy loads.

The Brush Electric Co. has a decided objection to using gearing in any form where the work can possibly be accomplished by some other means, and when it was found necessary to provide their new erecting room at Cleveland with a traveling crane, the opportunity for developing a motor which would be specially applicable to such purposes, and others where comparatively slow speed is required, presented itself.

The motor used for this purpose, at 200 revolutions, gives 10 H. P. with an efficiency equal to that of a high speed motor.

A crane is generally equipped with two motors of this type (longitudinal and hoist) and one for transverse movement of the trolley.

Our illustration is an enlarged view showing the three motors in their respective positions for longitudinal, transverse and hoist movements. The motors are self contained, and deviate from the usual construction of the Brush incandescent dynamos and motors in that the commutator is enclosed between the upright pieces forming the supports for the magnets, and there is therefore no out end bearing required. This reduces the space occupied by the motor very materially.

◆

Alarm for Hot Bearings.

A European journal gives an account of an alarm for hot journal bearings, the invention of one Christian Agerskof of Copenhagen, Denmark. The idea embodied is t arrange an explosive in associatio with certain chemicals, so that certain degree of heat will caus the explosion and warning befor the heat reaches a destructiv stage. A small piece of she metal, something like a cartridg shell, is filled about half way the open top with the explosiv A parafine globular capsule, hollo inside, is filled with sulphuric aci and sealed. This globule is laid top of the explosive and a mixtu of chlorate of potash and sugar filled in all around it; then a sto per or plug of cork or rubber put in, sealing the cartridge. hole is drilled in the box or bearin and the cartridge set in. Shou the bearing run dry the heat w melt the parafine capsule, lettin the sulphuric acid come in conta with the chlorate and sugar mix ure, which will immediately e plode the cartridge, causing a lou detonation, a light and a volume smoke, so that attention is immed ately called to the condition of th bearing.

◆

Boiler Inspectors for this City and the Ins ance Companies to Co-Operate.

Municipal Boiler Inspector Roberts and the inspectors employe by insurance companies held a conference recently on the joint inspe tion of boilers for the city. Th object was to agree upon an amend ment to the boiler inspection ordinance so that there will not be double inspection of insured boiler as at present. It was agreed th the insurance inspectors should b appointed as deputy city inspectors to serve without compensation. N insurance inspector is to be so ap pointed, however, until he has ha two years' experience in the business. They must furnish the recor of one annual inspection of eac boiler to the city inspector, and nominal fee is to be paid for a certificate, to be issued by the latte to the owner of the boiler. The design is to have the city inspecto examine all boilers not passed upo by the representatives of the insurance companies. This agreement was referred to Director Meye

ith the request that he incorporate
it an amendment to the boiler in-
ection ordinance. The amendment
ll be passed upon by Director
ardner and the Board of Trade
ommittee before it is submitted to
e Council.

Spontaneous Combustion.

Among the results brought to
ht through chemical investiga-
ns of the sources of spontaneous
mbustion, says the United States
ller, is the fact that sawdust
ould never be used to collect
ippings or leakages. Dry vege-
ble or animal oil is found to in-
itably take fire when saturating
tton waste at 180 degrees Fahren-
it and spontaneous combustion
curs more quickly when the cot-
n is soaked with its own weight
oil. Danger is involved in
tent "dryers," from leakage into
wdust, etc.; oily waste of any
nd, or waste cloths of silk or cot-
n, saturated with oil, varnish or
rpentine; also linseed oil drip-
ngs into a sponge, glycerine or
of any kind leaking into saw-
st, bituminous coal in large
aps of pit coal, hastened by wet,
d especially when pyrites are
esent in the coal—the larger the
eater the liability. Oil on flour,
water on flour, is productive of
ontaneous combustion. In fact,
l organic structures, being
rgely composed of carbon and
drogen, are readily excited, be-
use of the affinity of the hydro-
en for oxygen.

The Importation of Machinery into Egypt.

According to the annual report
the English consul at Alexandria,
e imports of metal and machinery
to Egypt from England have de-
eased in a significant manner
ring the past two years, while
e imports from Belgium and
ermany have increased. The
alue of imports of locomotives into
gypt last year was $334,500.
h le the previous year the loco-
otives came almost exclusively
om England, last year England's
roportion diminished to about
alf the total. In railroad cars a
oticeable decrease also occurred.
pumps, steam engines, etc., there
ems to be less demand, and Eng-
nd still heads the list.—[Das
andel's Museum.

Holiday Excursions.

The Lake Erie & Western R. R.,
nd Fort Wayne, Cincinnati &
ouisville R. R., running through
e Natural Gas region, will sell
r the Christmas and New Year
olidays, excursion tickets be-
ween all stations on its line, at
e very low rate of one and one-
ird fare for the round trip.

Tickets will be sold on Dec. 24,
5, 26 and 31, 1892, and Jan. 1 and
, 1893, limited going to date of
ale and good returning up to and
ncluding January 5, 1893.

For tickets, rates, time and gen-
ral information, call on any ticket
gent of the above route, or address
. F. Daly, general passenger agent,
r H. C. Parker, traffic manager,
ndianapolis, Ind.

A PRSSS dispatch from Indiana,
a., states that the success of the
lectric railway in the Beaver Valley
s said to be the inspiration behind
project to run an electric railroad between Indiana and Punxsutawney. Judge Harry White is one of the movers in the matter. The estimated cost does not much exceed $300.000.

Burlington Route New Service.

A through Pullman sleeping car, Chicago to San Francisco, is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train, at 1 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11:45 A. M., less than four days en route.

Chicago Excursion.

Excursion tickets will be on sale from December 3rd to 9th, inclusive; tickets good returning for five days. See Nickel Plate Agents.

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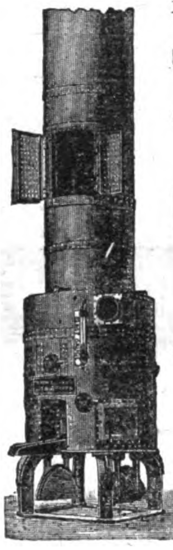

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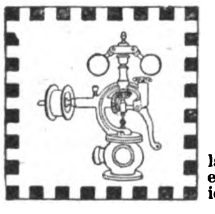

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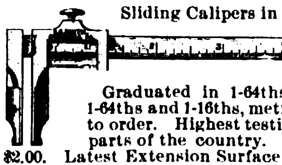

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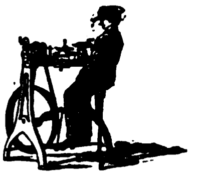

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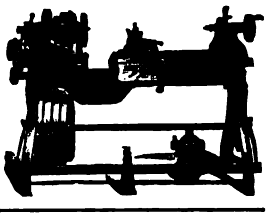

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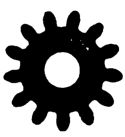

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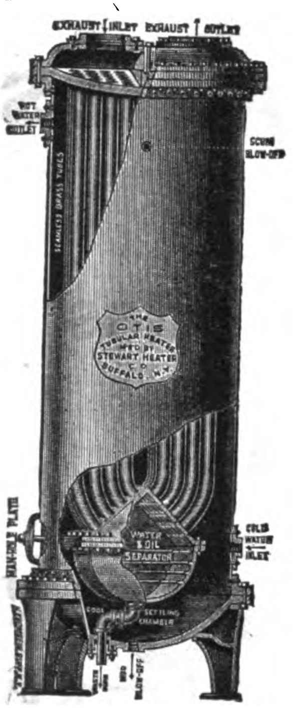

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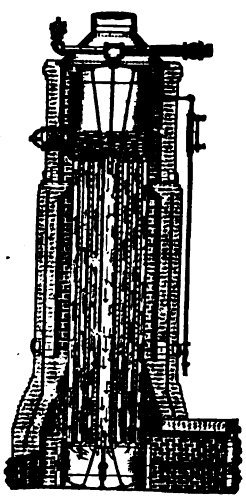

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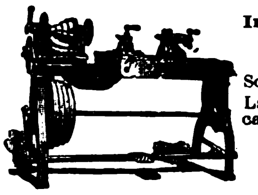

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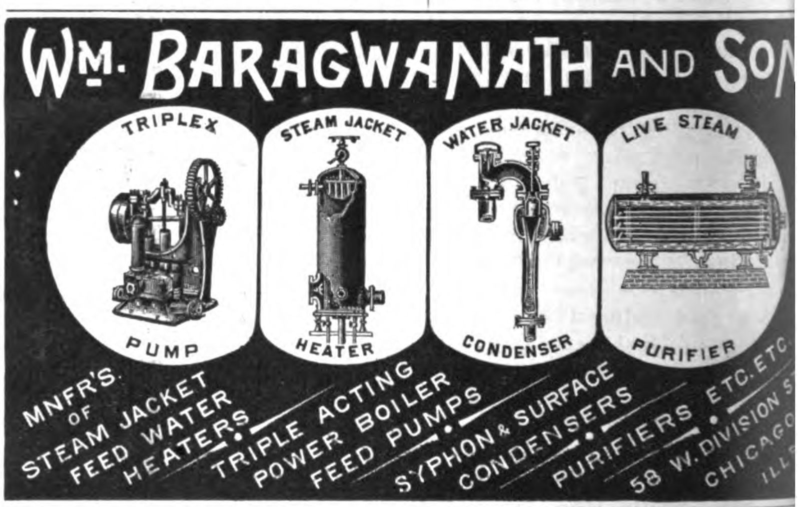

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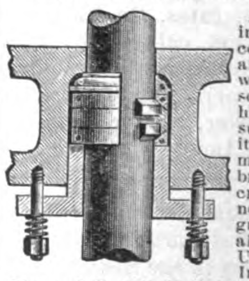

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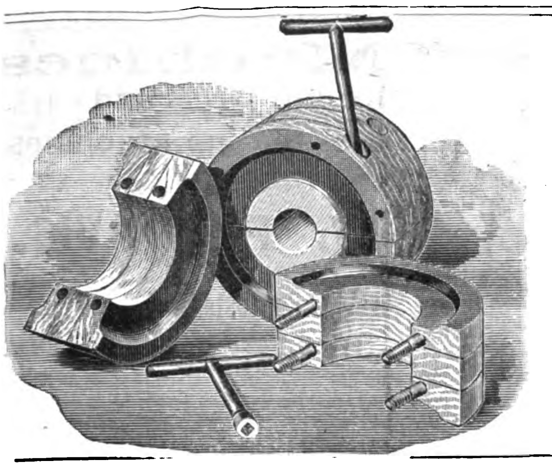

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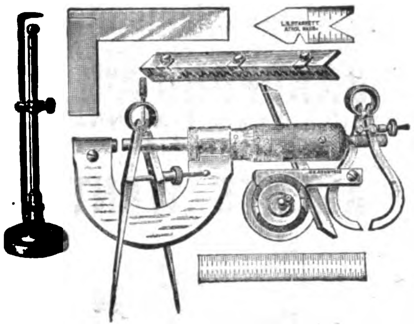

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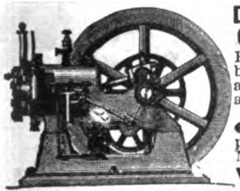

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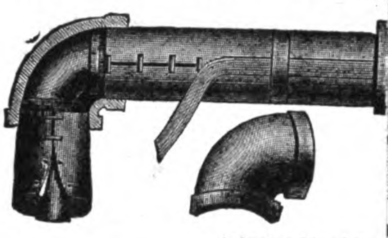

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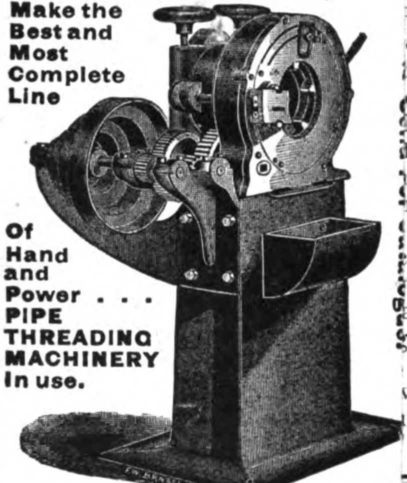

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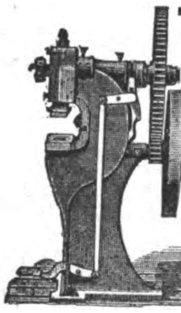

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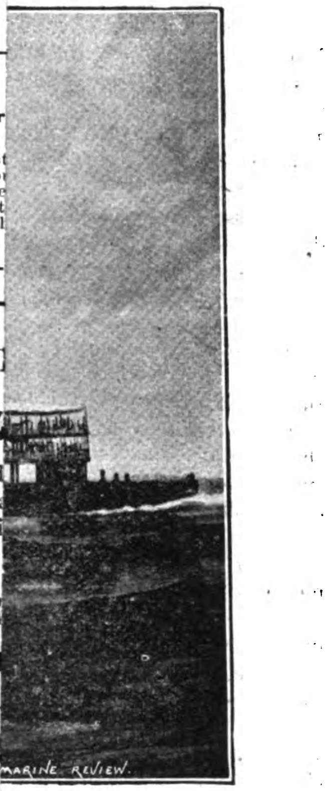

MARINE REVIEW.

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ELECTRICAL

An Armature Creates the Force that Resists It.

BY CLARENCE HOOVEN.

I was asked a short time ago, by an engineer, why it requires so much more power to run the armature of a generator several hundred revolutions per minute than to run it one-third or one-quarter that number per minute. For the benefit of any of your readers who may have been puzzled by this apparent anomaly in mechanical force, I will state briefly my explanation to the engineer alluded to.

To start an engine, for instance a locomotive, requires much more power than to keep up the motion after it is fairly started. But one can turn the armature of a large dynamo or generator with the hand. But while this can be done with a 400, 500 or 600 H. P. generator, to turn it three hundred or more revolutions per minute requires a large engine. The case of an armature at rest is not parallel with that of a locomotive at rest. The magnetic field, which resists the motion of the armature, is excited and made more dense by the action of the armature. This illustration is clumsy, but will do. Suppose a paddle is working in liquid, and the faster it works the thicker the liquid becomes. It can easily be seen that the accelerated speed of the paddle will cause it to meet with more resistance in proportion to its speed, and therefore the power to drive it must be increased in the same ratio. This is the case with the armature of a generator. The faster it runs the denser becomes the megnetic field and the more power is required to drive it through. My inquirer did not understand this perfectly.

The elements that constitute the magnitic field are called "lines of force." They resist the armature the same as the load on an engine resists the piston, and the more "lines of force" the more power is required to cut them. This is why a child can turn an armature around several times a minute, while to turn it several hundred times per minute may require a 100 H. P, engine. The ratio of work necessary to increase performance in a dynamo is inverse to that in most of the machines using power.

The Modern Developments of the Dynamo.

BY PROF. W. KOHLRAUSCH.

The requirements of electric lighting have tended during the past few years to the adoption of dynamos of 500 H. P. and over, and to all appearances the future will demand the construction of considerably larger machines. Such dynamos are usually coupled directly to the engine, and are therefore run at the same speed as the latter. The rotating parts of such large machines, running at present usually at the normal speed of 80 to 130 revolutions per minute, have a diameter of over 9 feet. This dimension is determined in the first place by the room required for the armature winding and by the conditions limiting its form, but the following also plays an important part in the determination of the dimensions of the machine.

The number of lines of force produced by the current flowing through the magnet coils cannot be increased at will by means of a possible increase in the winding of the bobbins and of the current flowing through the same, with a given sectional area of iron in the machine. A saturation point exists with every kind of iron, and this saturation point cannot be exceeded by any infinitely large magnetizing power. As the production and maintenance of the lines of force involve a relatively greater electrical loss in the winding of the bobbins (and consequently a relatively poorer total efficiency) the greater the magnetic density required, we employ in practice a magnetic density amounting to only about 30 or 50 per cent. of the maximum density. There are other reasons as well for using a limited magnetic density, with its accompanying condition of increased iron cross-section and larger machine dimensions in general.

It can hardly be doubted, then, that under such circumstances and in view of the growing demand for larger power units we shall soon reach the bounds of possibility, if the size of the dynamo is to increase in direct proportion to its output.

But, as we have seen, the capacity of a dynamo is limited by the room required for the armature winding, the number of lines of force and the number of revolutions at which the machine is to run. The question therefore comes up as to whether any considerable increase in the speed of dynamos is practicable, and whether this would be of any assistance.

In connection with the feasibility of an increase in the speed, careful attention must be given to its peculiar complicated construction from entirely heterogeneous materials. The rotating iron parts (and in the case of alternating current machines the rigid iron parts also) through which the lines of force flow, cannot be built up of one solid piece; they have to be made up in sheets or in some other divided form. The wires carrying the current must be carefully insulated from the frame of the machine and from each other, and the insulation material (hard rubber, micca, paper, the spun wire coverings, etc.) can only be introduced with great difficulty in the construction of a large machine. Then, again, the magnetic insulation of neighboring iron parts by means of unmagnetizable metals (brass, zinc, copper, etc.) is necessary in certain places. This explains why the purely mechanical engineer, who generally builds machines under far more favorable conditions, so far as materials are concerned, is not yet disposed to regard the dynamo as a machine. That precision in construction which we find in other machines is really lacking in the dynamo, and its calculation, both from a mechanical and electrical standpoint, is not nearly so sure as the calculation of a steam engine.

The increasing demands imposed upon the comparatively small homogeneous rotating parts of a dynamo at an increased speed, in the present general method of building up of these parts, present important and numerous difficulties in the construction, if the speed of a 500 H. P. machine is increased beyond 150 revolutions per minute. The difficulties would be greater with continuous current machines having revolving armatures than with alternators having rotating fields. But we shall undoubtedly learn how to overcome these difficulties so soon as reliable and simple high speed steam engines of suitable capacity are available. At present we, in Germany, adhere conservatively to slow speed steam engines, and rightly too, so long as it is a question of economical working, more particularly of economy in steam consumption. The construction today of large slow speed dynamos rests therefore to a certain extent on a compromise between the builders of steam engines and those making dynamos.

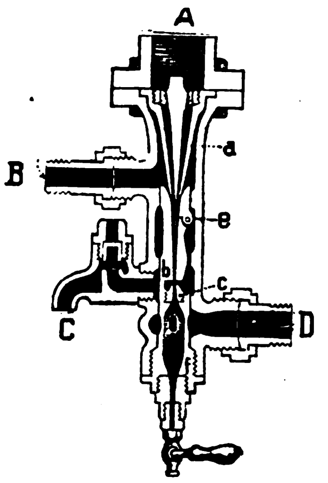
An increase in the number of revolutions of a machine would also be advantageous in various other ways, so long as its economical working is not seriously impaired thereby. Dynamos of the same output become small, lighter and cheaper, if the speed is increased. We can indeed increase one factor of the output of a dynamo, namely, the voltage, in proportion to the speed, provided the magnetic field remains constant. In the case of self-exciting machines the output does not, it is true, vary directly with the speed. The increase in speed will, assuming that the safe working of the machine is to be maintained, of course demand more solid construction and necessarily higher cost. The consequence is that the price of machines of similar capacity naturally diminishes very much more slowly than the speed is increased. Similarly the dimensions of a dynamo decrease more slowly than the speed increases, the output remaining the same in both cases. Practical data in this regard differ very much as comprehensive experience is wanting.

Dynamos require an extraordinarily steady running steam engine to drive them, as the fluctuations in voltage caused by irregularities in the speed affect the brilliancy of the light very materially, particularly that of incandescent lamps. The brilliancy of an incandescent lamp increases from three to five times as fast as its working pressure. It is for this reason that periodical fluctuations in the speed of the engine are objectionable. Engines driving dynamos must also be unaffected by severe and sudden changes in the load. The consumption of power in lighting work usually varies, it is true, so gradually that any good governor can act well enough. Sudden changes in the load, however, invariably occur, when, as the light consumption increases or decreases, additional machines are started up or others shut down, or when machines are changed over from charging accumulators to connection in parallel. In such cases all the governors used at present fail to act perfectly. Whether we shall attain something better with electrical regulation, perhaps between the terminals of the dynamo and the steam valve, experiments will have to decide.—[Abstract of a paper read at the general meeting of the Society of German Engineers, at Hanover.

THE EXHAUST INJECTOR.

BY LEANDER HAYNES.

Some time since I had the pleasure of reading before this association a paper on the exhaust injector, as I had found it in my every day practice. In that paper only a simple description of the device and a few points regarding its working were given, as I believed the injector was more or less familiar to all of you. I have been requested to present further data, regarding the same useful device; and for that purpose I have received certain data from others who have made injectors more of a study than I. Reference will be made in some cases to the former paper.



Ordinary injectors are operated by steam at boiler pressure and these instruments, as you are aware, supply feed water to the boiler by means of steam taken from the dome or steam pipe. One of these devices made by a standard firm, is a most desirable adjunct to any boiler and generally gives satisfaction. The greatest drawback to the ordinary injector, is that if it stops working for any reason, it must be manipulated before it will again start. This objection is, of course, met by injector manufacturers with the statement that their injectors never fail, but this is neither true nor correct. From my own experience, I will say, that I have never yet come across an injector, except of the kind I am about to describe, which was altogether automatic. The automatic feature is always set forth in strong language in the various descriptive circulars of each manufacturer.

With the exhaust injector, as I have found it, the case is different and I hope to make plain to your comprehension that in this we have an instrument which removes the uncertainty and at once inspires the user with confidence.

When first brought before the public, some eight or ten years ago, the exhaust injector did not meet with the great amount of enthusiasm among engineers that one might have expected; and yet.

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when the ordinary injector was first brought out, the engineering world was taken by storm, as it were, but this can, I think, be better accounted for, because engineers did not at that time understand its principles and many do not at the present day believe that the exhaust injector can accomplish its work with steam at atmospheric pressure. The statement appears too good to be true. Many engineers reach the hasty conclusion that an injector must have pressure of steam to operate it and that this pressure must be supplied from the exhaust pipe, which would then act as back pressure on the piston of the engine; hence, under such conditions there could be no economy by its adoption. In my former paper on this subject, I described particularly regarding the back pressure and why the effect of the exhaust was opposite.

Perhaps the most important point to be noticed in connection with the exhaust injector, is its perfectly automatic action. When the conditions for working are right, with plenty of steam and water to meet the requirements, the injector will work steadily; but supposing that the conditions vary, as for instance, the engine is running at varying speeds; then when the supply of exhaust steam is too little for the supply of water, the injector ceases to work, but as soon as the engine again supplies the requisite or usual amount of steam, the injector again re-starts itself without any manipulation whatever and will continue to work until steam is shut off from the engine, or the supply greatly reduced. When steam is wholly shut off, the injector will suck all of the steam from the pipe and the result is as remarkable to witness, as it is beautiful to contemplate.

By the aid of the model now before us, which is an injector with one side removed, I will endeavor to describe the construction and show the action of this excellent device. You are all, no doubt, familiar with the construction of ordinary injectors, but I will explain that the steam connection is shown at A, the water connection at B, the overflow at C, and the delivery to the boiler at D. Here we find, as in the ordinary injectors, three nozzles, namely, the steam nozzle, shown in the accompanying cut at A, the combining or mixing nozzle b, and the delivery nozzle c. Running through the steam and delivery nozzle, is a small fixed spindle, whose function is merely to concentrate the steam. It is to the peculiar construction of the combining nozzle that I wish to draw your special attention, as it is the most unique device ever placed on an injector, in order to assist in its perfect working. This nozzle is split from the smaller end or throat, backward for more than one-half its length, one-half being solid with the balance of the nozzle and the other half arranged to work freely on a hinge shown at e. This hinged portion enables the area of the throat to be enlarged or contracted according to the conditions of working.

The delivery nozzle is quite similar to that of an ordinary injector and is screwed into the cast iron body as shown at f, by which means the two nozzles may be withdrawn for examination and cleaning without disturbing any of the joints. This is a very desirable feature, especially when dirty feed water is used. When the injector is in operation, the water is delivered through the combining nozzle into the delivery nozzle and thence to the boiler; the velocity of the water between the two nozzles is such as to carry with it all the air inside the body of the injector. The temperature of the feed water that the exhaust injector will handle, averages nearly 180°. In my former paper, I gave some data as to the amount of water this style of injector would put into the boiler at a given time and also the weight of steam required to perform the work, which was about eight pounds water per one pound of exhaust steam.

The power or ability of these injectors to do work, when using exhaust steam, is a point on which many engineers stumble, for they cannot clearly see how steam with no apparent pressure can compel water to enter a boiler against a pressure of from 75 to 90 pounds of steam. The following explanation of the operation of the exhaust injector will assist in making this problem more clearly understood.

Steam at atmospheric pressure will rush into a vacuum with a velocity of 1,888 feet per second, while steam at 110 pounds pressure, flowing through an open pipe into the atmosphere, will have the same velocity. From this, we learn that steam at no pressure in the atmosphere will flow into a vacuum with about the same energy as steam of 110 pounds pressure escaping freely into the atmosphere. To understand this clearly, we must consider that in one case, the steam in its escape strikes nothing, while in the case of the higher pressure steam, it comes in contact with air, which acting as a cushion, retards its flow, so that its effective energy is reduced. This is the key to the mystery of the exhaust injector and I trust it has been made sufficiently plain for your comprehension. The velocity of steam given above may be verified by consulting any standard author on the theories of heat and steam.

In my former paper another point regarding oil going to the boiler by the use of the exhaust injector was mentioned; and you will pardon me if I alluded to the same subject again, for I will give some reasons why little or no oil is introduced in the feed water when it is supplied by the exhaust injector. The exhaust steam is not all equally charged with grease or oil, some, practically, being heavily charged, while other portions are free. The injector drawing its steam from the supply will cause the lighter or purer atoms to rush into the injector while the heavy particles will flow past and continue through the exhaust pipe.

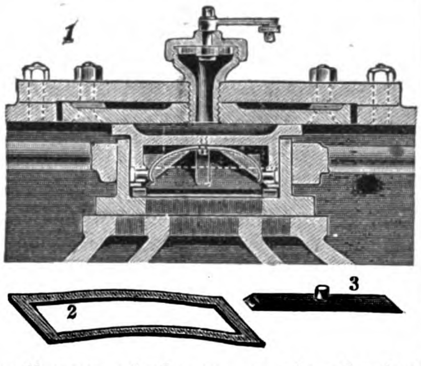
Economy is a great point aimed at now days and no matter how fine any injector may be, if nothing is to be gained by its adoption, it will not find much favor with engineers or steam users and I think it would be simply absurd on my part to attempt to prove that there is economy in the use of this invention which I have endeavored to describe. It is apparent to the simplest mind that if you can use over again that which has already done its work and cause it to do other work, there must be a saving in the operation; and this we find is the case in the use of the steam injector. It is a case of utilizing a waste product and making a gain by so doing.

There is also a saving of labor in firing which is a very important point for us to consider, for if we had an appliance which showed economy for the owners and put extra labor on the engineers, it would not find great favor with any of us. I cannot illustrate the saving of labor better than by repeating an anecdote, which I once read. A gentleman was being shown around a plant to witness the working of the injector and was taken into the fire room. The fireman in charge seemed exceedingly anxious to impress upon the gentleman in question, the many good points regarding an injector as a boiler feeder and wound up by saying that since the injector was applied he had gained fourteen pounds in weight. This kind of argument was, of course, conclusive.

I have not been able to describe all the principles involved in the operation of this device or give you as concise data as I wish; neither have I described all its merits; but I think you agree with me that the principles are there and that for an economical boiler feeder there is nothing on the market which will compare with the exhaust injector.—[Read before Robt. Fulton Ass'n, N. A. S. E., Nov. 5, 1892.

McDONALD'S BALANCE SLIDE VALVE

C. B. Botsford, writes to the Locomotive Engineers' Monthly Journal as follows: Having recently been shown a technical publication giving an illustration of Mr. McDonald's balance slide valve, I enclose a description of the same for the benefit of my technical brothers. It is of simple and durable construction, the illustration being made from a drawing of a valve fitted on a locomotive running on the imperial government railways of Japan, a six-wheeled coupled tender engine, wheels 4 feet diameter, cylinders 16 by 22 inches, and boiler pressure 160 pounds per square inch. The improvement has been patented by Mr. John McDonald, of the Railway Shenbasi, Tokio, Japan. The valve is formed with an open top, in which slides vertically a crown plate or cover adapted to be pressed by back pressure of the cylinder in contact with the face plate held on the steam chest cover. In the middle of the cover is a valve which opens into the steam chest over the space covered by the crown plate, the valve opening to the atmosphere when the live steam is shut off from the steam chest, whereby all vacuum in the cylinder is destroyed. In starting, there is ordinarily a momentary puff of steam, until the crown plate rises, and the operator can observe whether the valve is working balanced or unbalanced, according to the escape or non-escape of steam, a lever or link enabling the operator to close the openings of the valve as desired, when the improvement works like an ordinary slide valve. Fig. 3 represents the packing strip held by a curved spring in the end and side walls of the crown plate, and Fig. 2 is a spring preferably used, but not considered essential, to keep the crown plate against the upper face plate. It is said that one locomotive in Japan, provided with one of these valves, has run over 38,000 miles, showing no wear whatever, the trials thus far being so successful that other locomotives are being fitted with the improvement. An especially valuable feature of the device is that it automatically opens the cylinders to the atmosphere when the engine is running without steam, so that there is no vacuum created and no tendency to suck smoke and ashes into the cylinders.



The cut is loaned us by the editor of the Brotherhood Journal.

◆

A VERY interesting process at the works of the Crescent Steel Company, Pittsburgh, is the manufacture of drill rods by the use of a patented machine, which by a succession of compressions swages the rods (cold) to any required size, not only insuring a good finish, but uniformity of size, and an equal degree of condensation from circumference to center. In the production of these rods the use of wire gauges is strictly prohibited, and in their place is used the micrometer caliper, thereby working by actual measurement to correspond with a printed list of sizes, or with the decimal equivalents of fractions of an inch in common use. The demand for these rods, to be used for drills, taps, reamers, punches, etc., is constantly increasing, while the testimony in their favor, both for quality and uniformity of size, is a very strong indication that mechanics can now patronize American manufacture in the matter of drill wire, and still use the best which the market affords.—[American Manufacturer.

◆

A FRENCH engineer has invented a new crank, which he claims does away with the dead point. The crank-pin works in a slot cut in a steel disc fastened to the end of the shaft and is pressed upon by a spring, which is so adjusted that, at the ordinary working steam-pressure, it is held firmly in place If, however, the crank be at a dead-point, when the full pressure of the steam is admitted into the cylinder the spring is compressed, the crank-pin slides in the groove so as to assume an angular position to the shaft, and the latter begins to revolve. As the pressure of the steam in the cylinder while the engine is in motion is less than that in the boiler itself, as soon as the shaft begins to turn, the pressure against the spring is relieved, and the crank-pin flies back to its usual position. The tension of the spring is adjusted as necessary.

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THE DANFORTH CASE.

Recently an engineer on a United States cruiser was suspended for one year on half pay, because he did not leave his post immediately on receipt of a summons to appear before the officer of the deck, but waited a short time till he could be relieved. Mr. Danforth, the engineer in question, was "on watch." He was engaged in repairing or otherwise attending to some pipe, when a messenger was sent for one of his machinists to answer some offense. Mr. Danforth, not thinking this summons urgent, waited long enough to procure another man to take his place, sending word that as soon as this was done the machinist would be sent to headquarters. This did not satisfy the officer, and he dispatched an order for Mr. Danforth. The latter could not conveniently comply at once, and supposing that some information or explanation concerning the machinist was all that was wanted, returned word that he would report in a short time. For this he was arrested and is now under suspension.

The secretary of the navy should not have approved the recommendations of the officers who sat in judgement on the case. If punishment for so trivial an act of disobedience was necessary to preserve the rules inviolate, the rules should have been revised to meet the needs of the present. It is very likely that the rules were framed when conditions were very different from the present. When men-of-war depended principally on their sails for motive power, the "officers of the line" were the only individuals of any importance aboard—at least they thought so. The mechanism of the ship was of secondary consequence, and seamanship and artillery were the only qualifications of first consideration. The officers understood this. There was nothing connected with the machinery that required men of brains, as very little depended on the machinery. Red tape and severe discipline were in vogue and were the stock in trade of the "officers of the line." A midshipman just out of Annapolis, was a bigger man than any engineer. The rules of discipline now in force were probably made for the service as it was then. But how entirely the service has changed. A man-of-war today would be nearly as helpless without a competant naval engineer and a large corps of well trained assistants as a sloop of war fifty years ago without masts, sails or rudder. The motive power depends on the engineers, and the working of the guns, the handling of the ship and the comfort and sanitations of the great floating fort depend also upon them. The electric plant is of great importance, requiring a chief electrician of great skill. All this intricate and extensive mechanism is under supervision of the engineer. The engineer on watch is responsible for it all, and he is really a more important person to the efficiency of the ship than the man with shoulder straps who walks the most prominent deck. And yet, it appears that a coxcomb who supplies nothing essential to the navigation and usefulness of the ship can order this engineer to appear before him for any trifling cause, and if everything connected with the tremendous mechanism under his charge must stop still, that engineer must drop his work, suspend everything and run, under pain of dismissal, if not quickly enough to suit the vanity of the bunch of officiousness who sent for him. The rules need revision very badly. Mr. Danforth should be put back on duty, and protection afforded him, as well as every other engineer, not to mention the service itself. The engineer should either be an "officer of the line," or else the government of the ship so changed as not to keep him under the heel of a capricious lieutenant or other "graduate" from Annapolis.

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A MATERIAL which is being satisfactorily introduced for paving streets is composed of granulated cork and bitumen pressed into blocks, and which are laid like bricks or wood paving, the special advantage secured being that of elasticity. In roadways it furnishes a fine foothold for horses, and at the same time does away to a great degree with the noise that commonly accompanies city traffic. In Australia this method has been resorted to with excellent results.

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AFTER the trade incedental to holidays, the World's fair trade will begin, so that there is a busy year before us.

STATISTICS OF THE RUNNING OF A WATCH.

Watches were formerly highly esteemed, and the greatest care was taken of them, but since they have become cheap, they are ruthlessly submitted to all causes of destruction (falls, dust, sudden changes of temperature, magnetism, etc.), and the owners are sometimes astonished at their refusal to run. Yet, as compared with any sort of a machine, an ordinary watch is a marvel. A few figures will make this understood. The spring actuates the barrel, the motion of which is transmitted through three wheels to the escapement, whose wheel strikes the anchor or the cylinder of the balance wheel at an average rate of 8,000 blows per hour (with differences of from 3,000 to 4,000, according to the system). Another gearing retards the motion transmitted to the hour hand in the ratio of 12 to 1. All the motions of the watch are discontinuous, and are effected in little equal jumps, the number of which exceeds two hundred million a year in certain watches. Those who are careful about preserving their watches have them cleaned every two years, that is to say, after 300 or 400 million impacts. At the end of twenty years a well made watch, and one that has not been destroyed prematurely, must undergo a change of a few pinions, but it is after several thousand million of the little jumps that we have spoken of, and after the escapement wheel has made tens of millions of revolutions. If to this we add complications such as the chronograph and watches giving the date and repeating the minutes, we remain astounded at their possibility. As for the distance traveled by the exterior of the balance, that is so unexpected that all our readers, we think, will admit the result only after having verified the calculation.

The balance of a 19 line watch measures on an average 0.66 of an inch in diameter upon the regulating screws. It makes 5 oscillations of one revolution and a half per second, say a travel of 15.5 inches per second, 20 miles per day and 7,500 miles per year in round numbers. Now watches that give the perpetual date are provided with a wheel that makes one revolution in four years. During this time the balance will have made the tour of the world. The small amount of power utilized for the running of a watch is no less extraordinary. According to the Journal Suisse d'Horlogerie, a watch spring weighing 30 grains is capable of running a watch forty hours. At the rate of 72.5 foot pounds available per pound of steel we shall have 0.29 foot pound for forty hours, or 0.00725 foot pound per hour. One horse power develops in one hour 543.75 x 3,600 = 1,957,500 f. p. A watch requires then,

$$\frac{0.00725}{1,957,500}=\frac{7.25}{1,957,500,000}\text{ f. p.}$$

in other words, a one horse power would suffice to run 270 million watches, or probably all the watches that exist on the globe. And, again, it is the escapement that consumes the greater part of such power. In fact, the escapement wheel sets itself rapidly in motion and undergoes an abrupt stoppage, which, according to the principle enunciated by Lazare Carnot, always occasions a loss of live power, or, as we would say today, a waste of energy. The resistance of the air to the motion of the balance and the coiling and uncoiling of the hair spring also occasion losses. What remains for the gearing and the arbors? Not much, assuredly. And all this mechanism, placed under various conditions of position, temperature and air pressure, manages to run at less than a second variation, about, per day.—[La Nature.

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Production of Pure Iron and Steel.

A paper, read before the Iron and Steel Institute, described two new methods, one for making chemically pure iron and the other for making a steel with high carbon and low phosphorus economically in a basic furnace. To make a pure iron, charges composed of from one-half to four-fifths of good scrap, and one-half to one-fifth of good Swedish pig, were worked very quickly. The following is the analysis of the iron obtained: Combined carbon, trace; silicon, 0.005; manganese, trace; phosphorus, trace; sulphur, 0.015. Great care and watchfulness is necessary in working these charges, as the metal is liable to burst out of the furnace. This iron can only be in small pieces, even with the greatest care.

The principle of the second process consists in melting scrap with carbonaceous material, and the results of the experiments have shown that when a pure carbonaceous material and free from phosphorus can be obtained there will be no difficulty in producing a pure carbide of iron containing only sufficient manganese for forging. On the bottom and banks of the bath of a Siemens furnace with a basic lining, a layer of coarsely-broken limestone was evenly laid, and on this coke was charged; the scrap was then charged on the top of the coke, and the charge was melted down as quickly as possible. The scrap used in these experiments averages sometimes as much as 0.07 phosphorus and 0.03 sulphur. The scrap, as it melted, trickled down on to the coke, which not only reduced the oxide of iron formed in the melting, but also carbonized the steel, so that when the charge was melted the metal contained from 1¼ to 2 per cent. of carbon. A good furnace, working well, will require about 9 cwt. of coke to 14 tons of metal. When the charge was melted additions of ore (manganiferous ore for preference) and limestone were made as required, and the charge was worked in a similar manner to a charge in a silica-lined furnace, except that limestone was used. The amount of slag produced by this process is small, and it usually contains about 15 per cent. of ferrous oxide and 25 per cent. of silica. It has very little action on the banks of the furnace; the repairs, therefore, to the furnace bottom and banks are much less than when the charge is worked without coke.

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AMONG two hundred designs submitted to the American Express Co. for robber-proof cars is one with sides of boiler iron and arched roof. The door is on the side, and on top is a turret for armed men, with port holes for mitrailleuses.

QUESTIONS AND ANSWERS

[Readers are invited to use this department. All questions on mechanical and scientific subjects of a practical nature and of general interest will receive attention. The writer must give his name in full, but nothing that may identify him will be published with a question if he requests his name withheld. It will give the editor pleasure to assist, through this column, all readers, if possible, and he cordially solicits practical queries.]

(474.) U. Rorapaugh & Co., Smithville Flats, N. Y., write: "Will you kindly inform us through your Questions & Answers' column, the best way to finish up the surface of a 72"x16" wood rim pulley, after being turned?" A.—To finish the face of your wood pulley, first fill the face with a wood filler composed of silver white, thinned with naptha, using a little yellow ochre to color. Apply quite thick and after letting it set for five or ten minutes rub with excelsior or shavings. This will leave the face smooth. After letting it dry thoroughly, give it two or three coats of shellac, rubbing each coat down, if an extra nice job is desired. Any wood filler sold by the trade will answer the purpose of that above mentioned.

(475.) R. L. West, Brockton, Mass., writes: 1. "Please inform me about the meaning of the figures on an indicator card. For example, you see a card marked 'scale 40'; what does it mean?" A—The scale number on an indicator card means that the spring used in the indicator is of such strength that 40 pounds pressure in the cylinder will move the pencil just one inch in height on the card. Suppose the "card" to measure 1¾" in height and the scale is 40, then 40x1¾= 70 pounds = the pressure in the engine cylinder at that point. 2. "How do you find the mean effective pressure from a card?" A.—After finding the area of the space enclosed by the lines of the "card", multiply it by the scale number and divide this product by the length of the card in inches. Calling the area 3½ square inches and scale 40, and length of card 3¾" we have 3½x40 divided by 3¾ which gives us 37⅓ pounds as the mean effective pressure, usually written as M. E. P. This area can be found by using a planimeter or by estimating from measurements; but we cannot go into detail at this writing.

(476.) P. J. Munroe, Philadelphia, Pa., asks: 1. "Could you run a Corliss engine with one end of cylinder in case a valve bonnet broke on one steam valve? I claim it cannot be done with satisfaction or much power." A.—It has been and can be done without considerable trouble, except in starting or where the load varies greatly. For turning ordinary mill machinery it will run very well until a new one can be obtained. Running in this way it gives nearly as much power, and sometimes more, than when running both ends and cutting off every stroke. For when cutting off the steam follows less than half stroke on both ends, whereas running only one end and not cutting off allows steam to follow full stroke. On a high speed engine this would block the exhaust, but as a Corliss can not be successfully run at high speed this objection has less weight. Running on one end is not to be recommended as it is not economical nor convenient, but it can be done in a case of necessity.

(477.) W. K. White, Oshkosh, Wis., asks: "How can I keep my crank pin cool? The engine is running 250 turns per minute and runs an all night load, in a small electric station, but the crank pin will heat." A.—If the engine has a side crank the trouble may be remedied. Drill into the centre of crank pin a ⅜" hole and then meet this with one or more smaller holes drilled in from the bearing surface of crank pin. Tap hole in the end of crank pin and screw in a small elbow so as to leave the free end pointing to centre of main shaft. Screw a small pipe (⅛" iron or brass) into elbow, reaching nearly to the centre of the main shaft and finish by putting a ball on the end so as to have the ball come in line with the centre of main shaft. Have an opening in the side of this ball which will be in line with the centre of the shaft and connect with the pipe. Then you can stick your oil can spout into this and flood the bearing if necessary while the engine is running at full speed. Centre crank engines require a different method.

(478.) R. A. Wells, Fostoria, asks: 1. "How fast is a falling body traveling at the end of the fifth second of its fall, and how can I reckon this out for any case?" A.—At the end of the fifth second a falling body will travel at the rate of 160.8 feet per second, which is easily calculated from this simple formula: $V = G\ T$, where $V =$ velocity at end of any sceond; $G =$ the increment of velocity due to gravity, which in this latitude is about 32.16; and $T =$ the number of seconds. Then we have $V = 32.16 \text{x} 5$ or $V = 160.8$ feet per second. 2. "How far will it have fallen in this time?" A.—This involves a more complicated problem, the formula for which is: $S = \frac{1}{2}\ G\ T^2$ where $S =$ the total space fallen through in any given time and the other letters as before. As $G = 32.16$ then $\frac{1}{2}\ G = 16.08$ and it reads $S = 16.08 \text{x} 25$, which is the square or second power of 5, and we get $S = 402$ feet as the distance passed through in five seconds.

(479.) D. S. Darling, West Bend, Ia., writes: "Two parties whom we will call A and B are now having quite an argument over a small boiler, and have decided to leave the matter to you. The boiler is an upright. Its fire box is 24" in diameter and 20" high. There are 40 flues or tubes 2" in diameter and 36" long, their top ends opening directly into the smoke pipe. What is the H. P. of the boiler?" A.—About 6 H. P.

(480.) A. D. Johnson, Moosup Valley, R. I., writes: "I noticed in your issue of Oct. 15 directions for preparing graphite for steam fitting, but it does not give the proportion of either the graphite or plumbago." A.—Use enough linseed oil with the graphite (often called plumbago) to make a thin paste.

(481.) G. N. Collins, Savannah, Ga., writes: "Will you please answer a question for me? A friend and myself had a dispute about an engine being cold on a side track with no water in the boiler. The engine had two good injectors and a tank of water, and she was in condition to be towed. I claimed that the engine could be filled with water with the injectors, she being towed, and the cylinder cocks and whistle valve closed, with the throttle open; that every stroke which she took she would pump out the air that is in the boiler, the water taking its place. Was I correct?" A.—The water ought to be pumped in this way. The cylinders act the same as a pump.

(482.) Reader, Fairplay, Col., asks: "Can you inform me in your valuable paper regarding the process of making paper pulleys, and the materials used?" A.—To make a friction pulley, cut out of strawboard sections a little large than the pulley you wish to make. Bolt them tightly together between cast iron flanges, with a hollow hub, and turn off to the desired size.

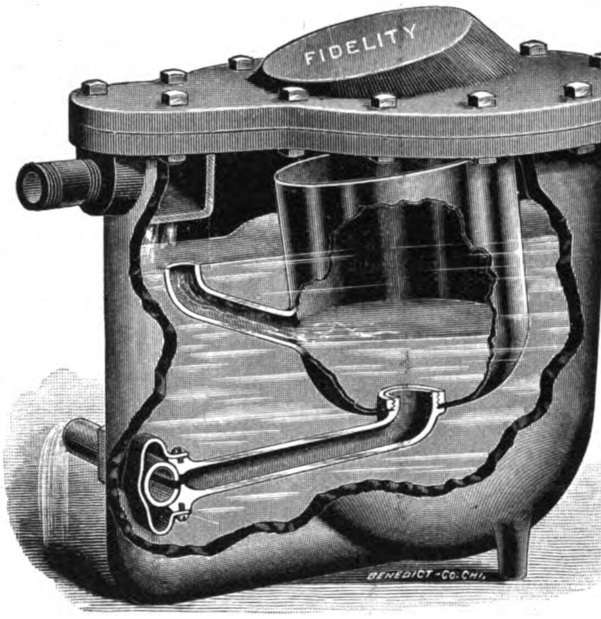
To cover a pulley, wind strips of tough paper around the pulley and glue securely.

(483.) John Starkey, Minerva, O., writes: "In the November 15 number of the SCIENTIFIC MACHINIST, is published an article on using exhaust steam for heating, by placing an ejector at drip end of radiators. We have a dryer with 10 radiators, each radiator containing 1,200 feet of 1" pipe. 1. How large an ejector will it require to create sufficient vacuum for the 10 radiators? 2. Is 1¼" pipe large enough to conduct steam from main line to each radiator? 3. Can we utilize all the exhaust steam of an 80 H. P. engine?" A.—1. Not a very large one. It depends on the kind and construction of the ejector. 2. Yes. 3. Do not think you can get it all through radiators of this size without blocking the engine—there is not enough area in the pipes.

☞Readers are cordially invited to send us any questions, comment, information, ideas or corrections that suggest themselves while reading the "Questions and Answers." The time to do it is when it is in mind. If one puts it off he is very likely never to get at it. Now is the best time. All communications are appreciated.—[Ed.

THE VAN AUKEN STEAM TRAP.

In presenting the accompanying cut of the fidelity steam trap, made by the Van Auken Steam Specialty Co., of Chicago, we wish to say but little, for there are but few parts in its make-up and, therefore, as to its construction little need be said.



THE VAN AUKEN STEAM TRAP.

We can simply state that there is nothing about it that can get out of order which can not be easily remedied. It is built on the most modern, simple, practicable and scientific principles. In a word, it will work wherever a steam trap is required, whether for high or low pressure, and as to its efficiency the manufacturers submit below just a few of the many hundreds of testimonials which are furnished gratuitously to them.

These traps are sent to users on 30 days trial, a proof of the confidence the manufacturers have in them.

Macomb Pottery Co., Macomb, Ills., under date of May 25, 1892, say: "We have in use in our factory two of your steam traps; we use them for draining the steam dryers for drying our ware. We think they are built on the right principle, and would not like to be without them. We are doing our drying with about two-thirds the coal formerly used."

Coaldale Brick & Tile Co., Coaldale, Jeff. Co., Ala., under date of May 25, 1892, write: "The No. 2 steam trap, purchased of you in April, works like a charm and enables us to keep dry steam in pipes continually. We drain 3,700 feet of one-inch pipe with it after passing through 160 elbows. We consider it indispensable to a successful working of dryer and recommend it to the trade."

Pioneer Hat Works, Wabash, Ind., under date of May 23, 1892, write: "The No. 3 steam traps purchased of you in February last have worked to our entire satisfaction, and have no hesitancy in recommending them to any one interested in this class of goods."

Further information, prices, etc., will be furnished by the Van Auken Steam Specialty Co., 203-207 South Canal St., Chicago, Ill.

* * *

A NEW parasite has been discovered which infects paper money and is found nowhere else. It is invisible to the unassisted eye, does not attach itself to persons, but multiplies at a rapid rate.

PRACTICAL LETTERS

A Handy Engine Tool.

EDITOR SCIENTIFIC MACHINIST:

In this age of rapid development and large increase in the size of shop work, tools of former years are inadequate to the needs of the times, and something rapid and less cumbersome as work becomes larger is demanded.

In other words, instead of the heavy work going to the light tool, we should make the light tool go to the heavy work.

Some years since, noticing the old methods of facing and boring the ends of Tangye bed plates for steam engines, for the attachment of cylinder, and the unreliability and incorrectness of the work done, also at the same time needing a tool for that special purpose, I designed a simple and comparatively light tool to attach to the bed plate lying on the shop floor independent of any heavy tool. The work done with it, I find as near perfect as attainable, by ordinary mechanical appliances. The plan of tool is: The bed plate slides are planed up true to the center lines, two saddles, one at each end of the slides, are bored and fitted centrally, for a suitable boring bar, running through both saddles, with a facing cutter-head traversing radially with bar, next to the end of bed plate to be faced, and driven by any suitable power attachment. This constitutes one of the most simple and efficient special light tools for shop work. In fact the tool with slightly modified attachments may be used for a variety of work to good advantage, and successfully for reboring engine cylinders, in place, without detaching from bed plate. In some instances, it has demonstrated the cylinder of a modern high speed engine to be $\frac{1}{8}''$ out of alignment with the slides of the bed plate.

E. FAWCETT, M. E.

How to Remedy Hot Bearings.

EDITOR SCIENTIFIC MACHISIST:

In reply to Victor Ferriott, Akron, O., question No. 460, in issue of Nov. 15th, if he will provide himself with a bottle of ammonia, say about one pint, and keep in a handy place, then when his hot box gets so he thinks it liable to fuse the metal, let him pour the ammonia in quite liberally, but not extravagantly, and then follow it up with a free use of good oil, and he will find the result "magical." Of course it is not expected that his bearings are adjusted too close, as in that case only slightly loosen the bolts holding down the cap, and there is no necessity for shutting down his engine.

S. R. M.,
Fort Steilacoon, Wash.

A Preparation for Cleaning the Hands.

EDITOR SCIENTIFIC MACHINIST:

One of the hardest things for a machanic to do, is to keep his hands clean. Dirt is honorable of course, and we care nothing about it when at work, but when at home and when out at any public gathering, we often feel ashamed of the dusky ridges and surfaces of our hands in which the grease has become so insinuated that almost no amount of soap and water will take it off. I think no one should object to clean hands, and I have a receipt that will enable any man to have them as white as a banker's (not as soft, of course), no matter how greasy his work is. The engineer I received it from, by its use keep his hands as free from grime as any lady's. When he "washes up" and sits down to supper you could not tell that he ever handled an oil can or a piece of greasy waste in his life. His wife and children (especially his daughters) are not ashamed to have their elite company see his hands. Of course they should not anyhow, but girls are sometimes unreasonably sensitive and you must put up with it. I, myself, do not think it is too much on the "Miss Nancy" order, to be particular about having perfectly clean hands, nor can I blame the women folks for wishing their men folks to look "nice" around home and when in company. I am an engineer myself and know all about it. But, the receipt. It is as follows: Mix together ½ oz. carbolic acid, 3 oz. glycerine and 4 oz. water. After washing the hands with soap and water and drying them, rub on some of this preparation, continuing the rubbing till they are dry. After it has been used a while, soap and water will take out the dirt and all of it. Its use should be kept up right along.

ARNOLD B. HORD.

Had not Been Opened for Fifteen Years.

EDITOR SCIENTIFIC MACHINIST:

I see in the SCIENTIFIC MACHINIST "Lectures by the Old Man," which I like very much. I am going to try and give my experience of a trip I had in the country to repair a boiler. In the first place I am a machinist by trade. I was sent way up in the country to fix some flues that were leaking very bad. The proprietor thought we would have to put new flues in, so when I got into the back end of the boiler, it looked as if there was not one from which a stream of water did not run, I looked for the hand-hole in the back end, but there was none, so I asked if there was any in front. The owner told me there was none, so I told him there must be one. I got out and went round to the front to see. In the meantime I asked how he cleaned his boilers,—how he got out the scale. "Oh," he said "we blow them off a little every day." Well after getting the ashes shoveled out, for they half covered the first row of flues, I dug down and got out some bricks. I found the hand-hole, to the surprise of all of them. I asked if he ever had cleaned out the scale, to which he gave a negative answer. That boiler had run fifteen years and never had been opened. I did all I could to have it opened and cleaned, but as soon as he saw the back end tight and another leak on side of shell, he got a man to lay up the brick, fired up, found all tight under pressure, coupled her to the other boiler and got them to work. The other boiler had been set up about 8 years, and had not been cleaned since set up.

The guage-cocks had pine sticks pushed into the many holes in them to hold water. Through some of them neither water nor steam could get, for they were plugged up tight. The cocks on bottom of glass gauges were plugged up and the lower guage-cock of one boiler was eaten right off. All that I could see, that held it in place was a mass of scale crowded around the pipe and against the boiler.

ANOTHER OLD MAN.

Hot Bearings.—How to Get Pure Water.

EDITOR SCIENTIFIC MACHINIST:

I would suggest to Mr. Ferriott, (question 460 and answer to 465 in Nov. 1st, issue), that in my experience, with hot boxes and cooling them off, nothing has given me better satisfaction than cold beef tallow and plumbago, as the tallow cools and the plumbago polishes the bearing.

In answer to J. B—— Co., question 469, who are taking water from the creek, which is not pure, as they say, I once came in contact with the same evil, and can tell them what I did. I dug a well 30 feet from the creek. I dug down even with the bed of the creek and struck gravel. Water was also struck, but I went six feet below the gravel. To hold a sufficient supply of water, I boxed it up, boring a sufficient number of 1″ holes in the side next to the inlet, for the water to enter. I had plenty of water for my boiler and it was clear and well filtered. If their plant is situated so as to do in like manner, they may get relief in this way.

MR. H.

It Bothered Experts.

EDITOR SCIENTIFIC MACHINIST:

In regard to George S. Ramsey's conundrum for engineers, I have known of a balance wheel being slightly loose and caused a thump, which bothered experts to locate, and have known one to burst from the same cause.

A. D. JOHNSON.

WATER-HAMMER.

Water-hammer in steam pipes has been a source of a great deal of annoyance, and many accidents have occurred from this cause. Water-hammer has been explained, says the Manufacturer and Builder, as concussion of water in the pipes, due to a vacuum having been formed by the condensation of steam, permitting the water to flow from different directions toward the point where the vacuum was formed, the momentum being sufficient, when striking another body of water, or a bend in the pipe, to produce a regular hammer-like blow, which often starts the joints to leaking, or breaks the pipe apart. This effect, when it occurs with any degree of intensity, is usually disastrous to cast-iron pipe, as the tenacity of the cast iron is not sufficient to withstand the sudden blow.

Wrought-iron pipes, when connected with cast-iron fittings, also suffer from this cause. This effect usually takes place when steam is first turned into cold pipes, for then the condensation following the abstraction of heat for warming the pipes, leaves a quantity of water, which is driven along ahead of the steam; but as steam travels faster than the water, it will soon get into the pipe ahead of the water, and, by condensing, forms another and separate body of water, as it were, which will occupy a certain portion of the space in the pipe. As the rush of the warmer water continues, the two portions will meet with steam imprisoned between, but condensation will take place quickly at this time, and the partial vacuum formed increases the velocity of flow of the water until the momentum is expended on a bend in the pipe, or against water flowing in the opposite direction, and the resulting blows will greatly strain, if they do not rupture the pipe.

Numerous accidents have occurred from the effects of water-hammer, and it is only a short time since a 10-inch cast-iron steam pipe burst from this cause and the strangest part of it is that the pipe broke in two places, but then that is accounted for because there was a bend in the pipe near the point at which one of the breaks occurred.

A recent accident due to water-hammer, occurred to a boiler in an establishment near Pittsburgh, where one boiler of a battery was cut out by drawing the fire and shutting off the feed, the steam connection being left open as was customary, although a very dangerous and uneconomical practice. Condensation of steam continued, of course, until the boiler had filled with water and it had become comparatively cold; then as the blow-off cock was opened and a portion of the water let out, steam entered to fill the space, and, meeting with cold surfaces, condensed rapidly and produced water-hammer of different degrees of intensity in different parts of the boiler and pipes, with the result that the boiler began jumping on its foundation and the pipes were so badly shaken as to leak at nearly every joint. Other damages occurred which go to show that the force was considerable, as the effect was felt in nearly all parts of the battery of boilers and the attachments. What damage was done to the boiler is not stated, but it was to be inferred that it was considerable.

The accident could hardly be attributed to carelessness or ignorance of the engineer on watch as the practice was customary at that place; but the well known effects of water-hammer should have caused the engineer to proceed with caution when letting water out of the boiler, or rather he should have closed the valve in the steam pipe when the boiler was first laid off. Leaving a steam valve open in this manner, in connection with a cold boiler is an expensive proceeding, even if no accident follows, for the condensation of steam in the cooling boiler will continue until it is again fired up and the boiler produces steam of the same pressure as that entering from the steam pipes. Considering the amount of radiating surface thus exposed, it would require but very little calculation to show that every hour such conditions exist, fuel in appreciable quantities is being wasted.

Letting steam in on top of the water in a boiler injuriously affects the boiler plates by the greater expansion produced on the upper portion, that being of the same temperature as the steam, while the bottom part of the boiler is decreasing in temperature until it becomes about the same as that of the surrounding atmosphere, producing a difference of 250° or more. Owing to the poor heat conductivity of water, any heat applied to the surface cannot penetrate to an appreciable depth; consequently, the boiler is left under a strain that cannot do otherwise than injuriously affect the plate, and more especially when heat is again applied to the bottom of the boiler for raising steam, the conditions due to expansion are changed. The injurious effects of contraction and expansion of boiler plates are well known, but the various conditions under which they may be produced are not so clearly understood.

Heating the top of a boiler by the introduction of steam above the water is certain to produce a greater amount of expansion than will ever occur under the usual conditions of the application of heat, for when steam is introduced above the water, the iron is soon heated to nearly the same temperature as that of the steam, while that portion of the boiler below the water line remains many degrees colder.

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Steam on the Highway.

Peter Chalmers, a farmer of Farmington, is a genius in his line.

All the plowing done on Chalmers' big ranch is done with a traction engine, and during the last plowing season he ran the engine day and night.

Now the farmer is hauling wheat to town with his engine. He brought a load in recently and stored it at the Stockton Warehouse. The aggregate weight of the nine wagon loads was nearly 42 tons. The farmer has 30,000 sacks of wheat to haul.

"Is it much cheaper to bring the wheat in this way than it would be to ship by rail?" was asked of Mr. Chalmer.

"Well," was the reply, "I can't positively say that it is any cheaper at all, but I think it is. The wheat I'm bringing now comes from near Farmington, which is seventeen miles from Stockton, and it would cost $1.10 a ton to get it here by rail. Some of the wheat I'm going to haul is farther away, and to transport it on the railroad would cost $1.50 a ton. I don't think it will cost me a dollar a ton on the longest haul."

"One has to load his wheat anyhow, and if he ships it by cars, he's got to unload it on the cars. That requires men and time. This way all we've got to do is to load it in the field—the warehouse men do the rest. It requires only three men to take care of our train—an engineer, a fireman, and a man to look to the wagons and see that they don't get 'hot boxes.' "

"But," said the reporter, "there's the interest on the money in the engine, which cost—"

"Four thousand five hundred."

"And then there's repairs and the steady wear of the machine; and you've got to have a lot of money invested in wagons. You would only need a couple of wagons to haul to the railroad, but this way you need a dozen."

"Oh, I need the wagons and the engine on the farm, anyhow," was the reply.

Mr. Chalmers also said it would not be feasible to haul grain as he is doing except on level and good roads. The tender carries water sufficient for only twevle hours' consumption. The engine can haul the train at the rate of four miles and a half an hour.—[Stockton Mial.

THE GOLLMAR BELL RINGER.

This device works by either steam taken from the boiler or air from the air brake. It entirely obviates the use of bell rope and is the most simple, durable, and reliable bell ringer made. It can be used as an automatic bell ringer by ringing the bell continuously, or with the use of the automatic starter may be rung at intervals when required (Fig. 1). The automatic started causes the bell to ring immediately upon sounding the whistle. This in itself is of great value to railroad companies in lawsuit for damages arising from death or injuries, where it is important to establish the fact that the bell was ringing. The automatic starter impeaches the evidence of those over-zealous witnesses, who almost inevitably swear that the bell was not ringing at the time of an accident, but dare not swear that the whistle was not sounded, as it can be heard further and can be proven to have been sounded. This is done by taking the jury to the engine and requiring them to sound the whistle. The result is obvious. The bell will start ringing and ring until stopped by hand. It has also the desirable feature of re-starting the bell to ringing when it is stopped from any cause and forgotten on roads that require the bell to ring continuously. The first crossing signal does the work, and it does not forget to ring the bell when it should be rung, as often occurs when the engineer and fireman are depending on each other to start the bell ringing. It meets the approval of all railroad attorneys when their attention is called to this feature. Besides affording protection to life it has many other advantages of security, which renders it almost indispensable. It has more means of adjustment and is more economical in the use of air or steam than any other. At its low price it will be found cheaper than bell cords and will last as long as the engine. This is the only bell ringer that can use any kind of automatic starting device without license from patentee.

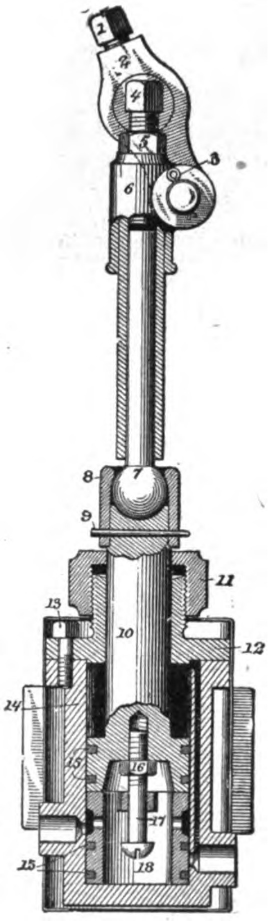


Fig. 2.

The construction and its action are as follows (Fig. 2): There are two openings for pipes; the upper one is the inlet, the lower is the exhaust. Pressure is admitted through upper opening, opposite an annular groove in valve 18, through which four holes are drilled, admitting the pressure under the single action piston 10; this causes piston 10 to rise, forcing the bell to swing.

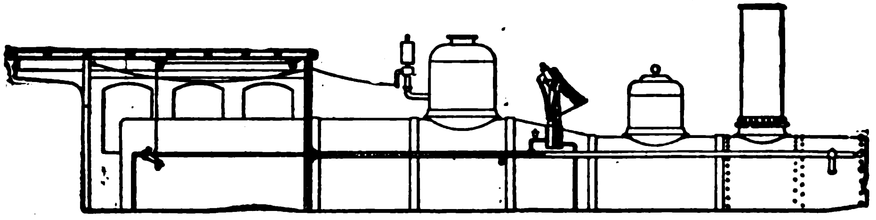


Fig. 1.

Piston 10 has a stroke of $1\frac{1}{4}''$ when at its extreme travel; crank 2 has a stroke of 4″. The connecting rod is in two sections, 6 and 7, which allows the crank 2 to make a complete revolution without causing piston 10 to move. When the ringer is started to work the piston 10 will be driven upward, causing the bell to swing, and valve stem 17 will raise valve 18, closing inlet port and use pressure expansively by traveling the length of the lap before it will open the exhaust port. The bell, having received an impules, will continue its motion after the piston 10 has reached the upper end of its stroke, the crank box 6 sliding on rod 7. The impetus which the bell receives being expended it will fall; the set bolt 4 will strike the end of rod 7, the piston 10 will be forced downward, coming in direct contact with valve 18, closing exhaust port and opening inlet port after cushioning on the pressure remaining under piston 10 after exhaust is closed. It will be seen that valve 18 is only operated at the terminations of the piston 10 stroke. Packing rings 15 on piston and on main valve are packing rings D 6–No. 8 Westinghouse Air Brake Co., catalogue 1890, and are duplicates of those used in air pumps. As the rings are kept in stock by all railroads using air brakes no extra supply need be carried by them. This is the only bell ringer that can be adjusted to use pressure in proportion to the power required. This is accomplished by means of valve stem 17, which is secured in its adjusted position by jam nut 16. No change in length of connecting rod is required in making this adjustment. These bell ringers are in use that cut off pressure after piston has been moved $\frac{3}{8}''$ on its stroke. This arrangement makes it so economical in use of pressure that air is always used in preference to steam. This bell ringer has been adopted by several Western railways and is in use on many others. It is made by the Gollmar Co., Baraboo, Wis.

The description and cuts are from the Locomotive Engineers' Monthly Journal.

◆

Ammonia Motors.

Mr. P. J. McMahon, claims that his new system of street car propulsion which appeared in the field not long ago, is a formidable rival of the electric, cable and horse car. While some say it "can't be done," remembering what the same people said of every street railway motive power now in use except horses, it is well to give it careful consideration.

The principle on which this invention is based is the use of ammonia gas in the place of steam for operating the piston of an engine placed beneath an ordinary street car. The cylindrical reservoir from which the gas is supplied to the engine or tank surrounding the reservoir for the reception and absorption of the exhaust gas after it has done its work on the piston are also placed beneath floor of the car.

Three gallons of anhydrous ammonia will give off sufficient gas, it is claimed, to run a 15-foot car one mile on average grades and roads, exerting a pressure of 150 pounds per square inch on the piston of an ordinary engine at a temperature of 80° Fahrenheit, which is the temperature at which the weak solution surrounding the anhydrous ammonia reservoir was charged into the tank.

It is claimed that a 16-foot car can carry a sufficient charge to run at least twenty-five miles.

The cost of preparing the anhydrous ammonia as used at the station is claimed to be less than one cent per car mile, and as there is no loss in distributing the power over the route, as in either the cable or the trolley system, it is therefore claimed that this system can be operated much cheaper than either of the latter. Careful tests have been made both in this country and England with very satisfactory results.

◆

Transferring Handwriting to Iron.

An article in a continental journal recalls the incident of the invention of a method of transferring handwriting to iron. A Boston founder noticed one day that a ticket which had accidentally slipped into a mold lightly transferred its type to the iron. He followed up the hint thus afforded him, and procured a heat proof ink, with which he wrote invertedly on ordinary white paper. This paper he introduced in the mold before the molten iron was poured in. When the mold cooled it was found the heat had consumed the paper, but that the ink, which remained intact, had left a clear impression on the iron.

◆

Recent experiments have been made with ramie fibre as a substance for making steam pipes. The material is subjected to tremendous hydraulic pressure, and, being unaffected by moisture, will neither shrink nor swell, besides being a non-conductor of heat. These pipes are said to have twice the tensile strength of steel pipes.

◆

Steps are being taken to establish telephonic communication between Denmark and Sweden, under the sound.

STRUCTURE OF THE STEAM-ENGINE.—V.

BY PROF. R. H. THURSTON.

THE PORTER–ALLEN, BUCKEYE AND STURTEVANT ENGINES.

The Porter-Allen Engine was the first of the class known as "high-speed" engines. Its designers were Mr. C. T. Porter and Mr. J. F. Allen, the latter being the inventor of its valve-gear; while the former was the pioneer in the introduction of engines of this class.

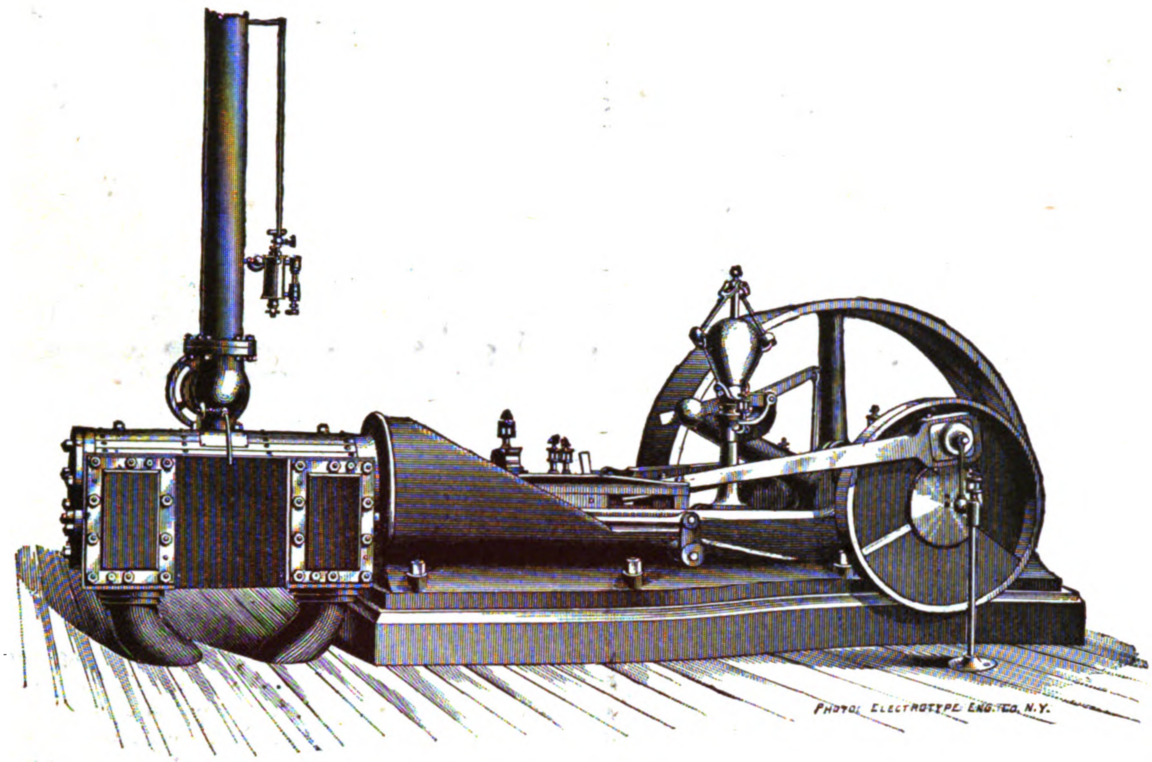


PHOTO. ELECTROTYPE ENG. CO. N.Y.

FIG. 46.—PORTER-ALLEN ENGINE.

In the Allen engine (Fig. 46), the cylinder and frame are connected as in the engine seen in Fig. 25, and the crank-disk, shaft-bearings, and other principal details are not essentially different. The valve-gear differs in having four valves, one at each end on the steam as well as on the exhaust side, all of which are balanced and worked with very little resistance. These valves are not detachable, but are driven by a link attached to and moved by an eccentric on the main shaft; the position of the valve-rod attachment to which link is determined by the governor, and the degree of expansion is thus adjusted to the work of the engine. The engine has usually a short stroke, not exceeding twice the diameter of cylinder, and is driven at very high speed, generally averaging from 600 to 800 feet per minute. This high piston-speed and short stroke give high velocity of rotation. The effect is, therefore, to produce an exceptional smoothness of motion, while permitting the use of small fly-wheels. Its short stroke enables solidity to be attained in a bed of rigid form, making it a self-contained engine adapted to heavy work, and requiring but a small foundation.

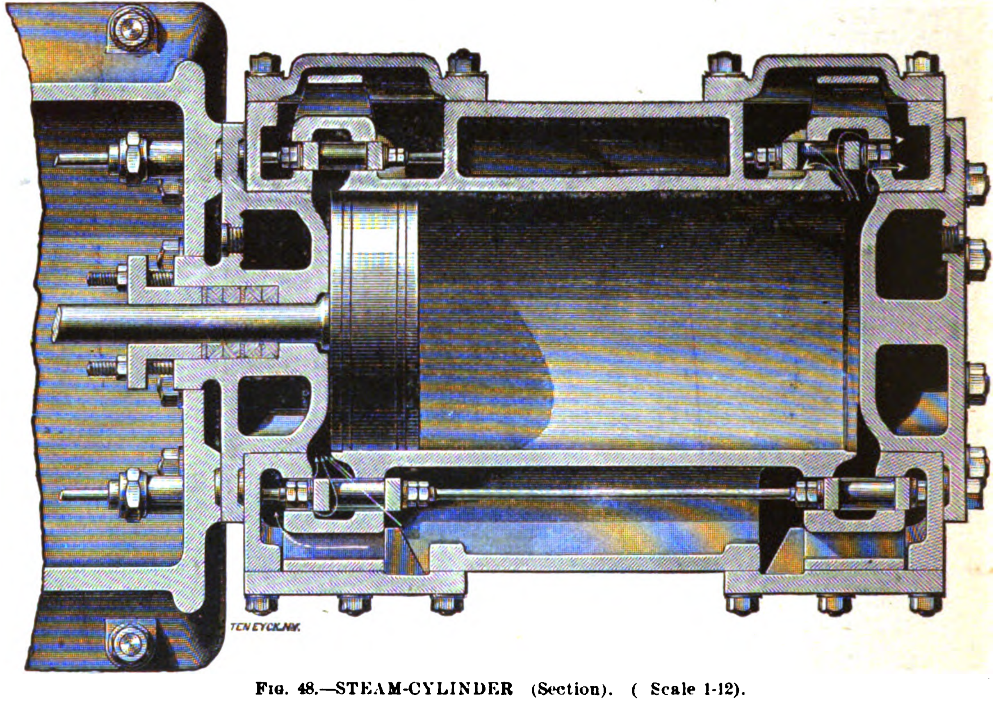


FIG. 48.—STEAM-CYLINDER (Section). (Scale 1-12).

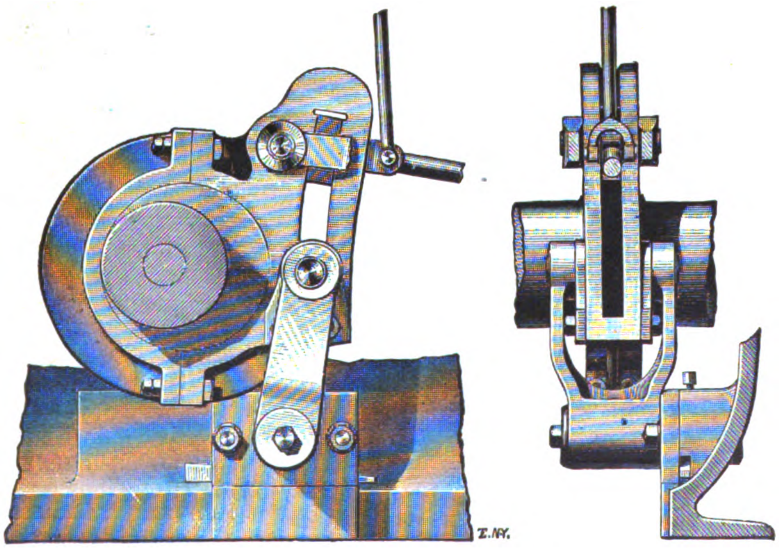


FIG. 47.—THE ALLEN LINK. (Scale 1-16.)

The journals of the shaft, and all cylindrical wearing-surfaces of such engines, are finished by grinding, and are thus made perfectly cylindrical. The crank-pin and cross-head pin are hardened before being ground. The joints of the valve-gear consist of pins turning in solid ferrules in the rod-ends, both hardened and ground. After years of constant use thus, no wear occasioning appreciable lost time in the valve-movements occurs.

Where great steadiness of motion is desired, the expense of coupled engines is often incurred. Quick-running engines do not often require to be coupled; a single engine may give greater uniformity of motion than is usually obtained with coupled engines at ordinary speeds.

The governor used on this engine is known as the Porter governor. It is given power and delicacy by weighting it down, and thus obtaining a high velocity of rotation, and by suspending the balls from forked arms, which are given each two bearing-pins separated laterally so far as to permit considerable force to be exerted in changing speeds without cramping those bearings sufficiently to seriously impair the sensitiveness of the governor.

In "high-speed" engines, the possibilities in the direction of increasing speeds are sought to be made the most of. Their market is not only to be found in the domai the electrical generation of li and electrical transmission of po but in older fields of work as The loss of power in the "j shafts," or "first-motion shafts mills and workshops driven by low-speed engines is an item o inconsiderable amount in m cases. The tendency is now servable toward the adoption o higher speed of engine, in di connection with the main li shafting, even where not quit economical in the use of st through the intermediary of a si belt or pair of gears, or even directly attaching the crank-s of the engine to the main line coupling.

Mr. Allen's invention of a va gear placed in the hands of Porter, who was endeavoring design a "high-speed" engine, device needed to carry out the i

This arrangement consists single eccentric driving a l motion to operate the steam-v and to work the exhaust at same time. The link is contro by a Porter governor, and i connected and driven that the may be readily and quickly adju by the governor to any des point of cut-off. The eccentric link are shown in the next illus tion. The eccentric is set on shaft in such a position that motion is coincident with that the crank. The link is a slo curved arm, forming one piece the eccentric-strap, pivoted at middle on trunnions sustained an arm rocking about a pin set the bed of the engine. The up end of the link carries a pin, f which a rod leads off to the exha which is driven without varia connections. The link-block fitted to work in the slot of link, from the end nearest the haust-rod pin, down to the po opposite the pivotal point at wh the trunnions are set. When it at the upper end, the throw of valve is a maximum; when at lower point, it is a minimum. the link-block is moved up and do in the slot, the motion of the va is varied, and the ratio of expans correspondingly altered. By an genious adjustment of a still m ingenious form of valve-motion is thus possible to obtain a va movement of perfect precision at speeds, and on both the forw and the backward stoke, with a quicker closing action, as the cut-off is later. The steam is allowed

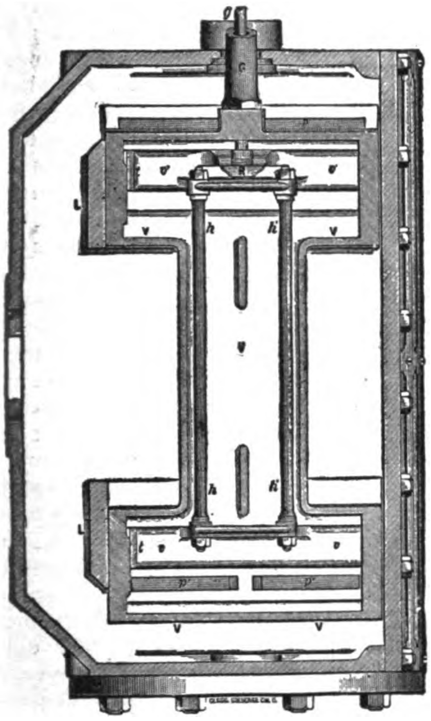


Fig. 49.—PLAN OF VALVES.

to enter the cylinder, at nearly boiler pressure, almost up to the point of cut-off, and the expansion line is a smooth curve very nearly

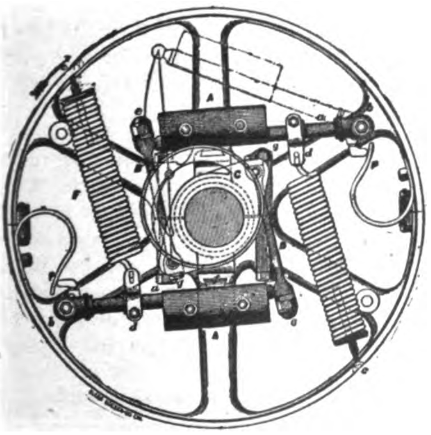


Fig. 50.—THOMPSON'S GOVERNOR.

from the junction with the steam line.

The four valves are shown in the next figure, which is a section through the steam-cylinder showing valve, ports and general construction. The two valves at the upper side of the cylinder are the steam-valves; the lower are the exhaust-valves. This section is, however, horizontal, the valves being set on their edges at either side of the cylinder. The exhaust-valves are so placed as to drain the cylinder of any water that may have entered with the steam, or may have been produced by internal condensation. Both sets of valves are so made, and set, as to be well balanced, and so as to be capable of having the wear taken up when it occurs. The steam-valves are provided with packing-plates, which are adjustable by hand, to make them steam-tight, as well as to secure a perfect balance. Each valve is placed in a separate valve-chest, and can be independently adjusted. Each valve opens four ports; each is so set that it is actuated by a rod in the line of its own centre; and all are thus rendered but little liable to either wear or leakage. The rock-shaft arm on the intermediate rock-shaft, between the eccentric and the steam-valve stem, assists in securing the quick opening and closing motion essential to a satisfactory distribution of the steam.

The features which have been described are not necessarily distinctive of a "high-speed engine." A positive-motion valve-gear, and a good steam-distribution, are desirable in such engines, and the first point is, in fast-running machines, an essential requisite; but the engine, so far as it has been described, may be as well considered a slow as a fast engine. There are some details which are essentially and peculiarly characteristic of the class to which this machine is assigned. Among these points are the strength and rigidity of parts which distinguish such engines; the great nicety of fitting; the excellence of all material in every part exposed to the straining action of inertia, and the minor modifications of details to adapt them to service in a machine in which play in joints or bearings will make trouble.

The bed is stiff and solid, especially in those parts which take the stresses of the reciprocating pieces. It is broad and deep, with the line of thrust of piston-rod carried close to its surface between the guides, and with a box form which gives great resistance to forces tending to twist it. The steam-cylinder is secured to the bed by the end, a construction adopted by Corliss many years ago, and one which gives all desirable strength, with freedom from those strains which come of connection of two large masses at different and constantly varying temperatures. The main journal-boxes are made in four pieces, and are set up by adjustable wedges, so set as to avoid the springing of the shaft that is sometimes found to occur with a less effective arrangement. The main-shaft journals, and the journals of the crank-pins, are made with especial care, skilfully ground to size and form, and nicely finished before the engine is assembled. The pin is of "mild" steel, carefully case-hardened to give it a surface that will wear well and will not "cut." The provisions for lubrication in such engines are among the most important of its details.

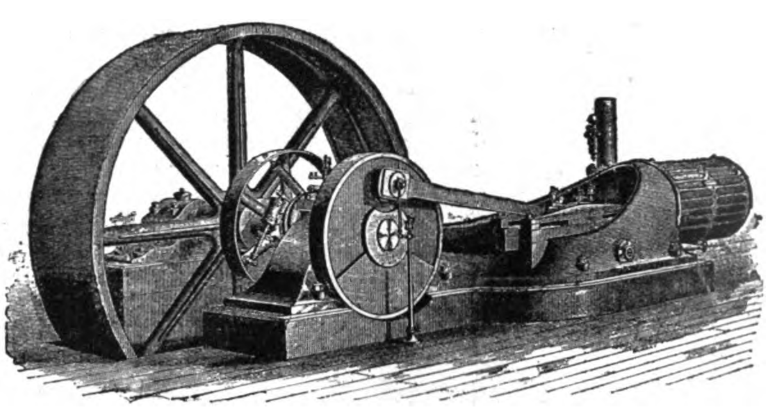


Fig. 51.—THOMPSON'S SYSTEM.

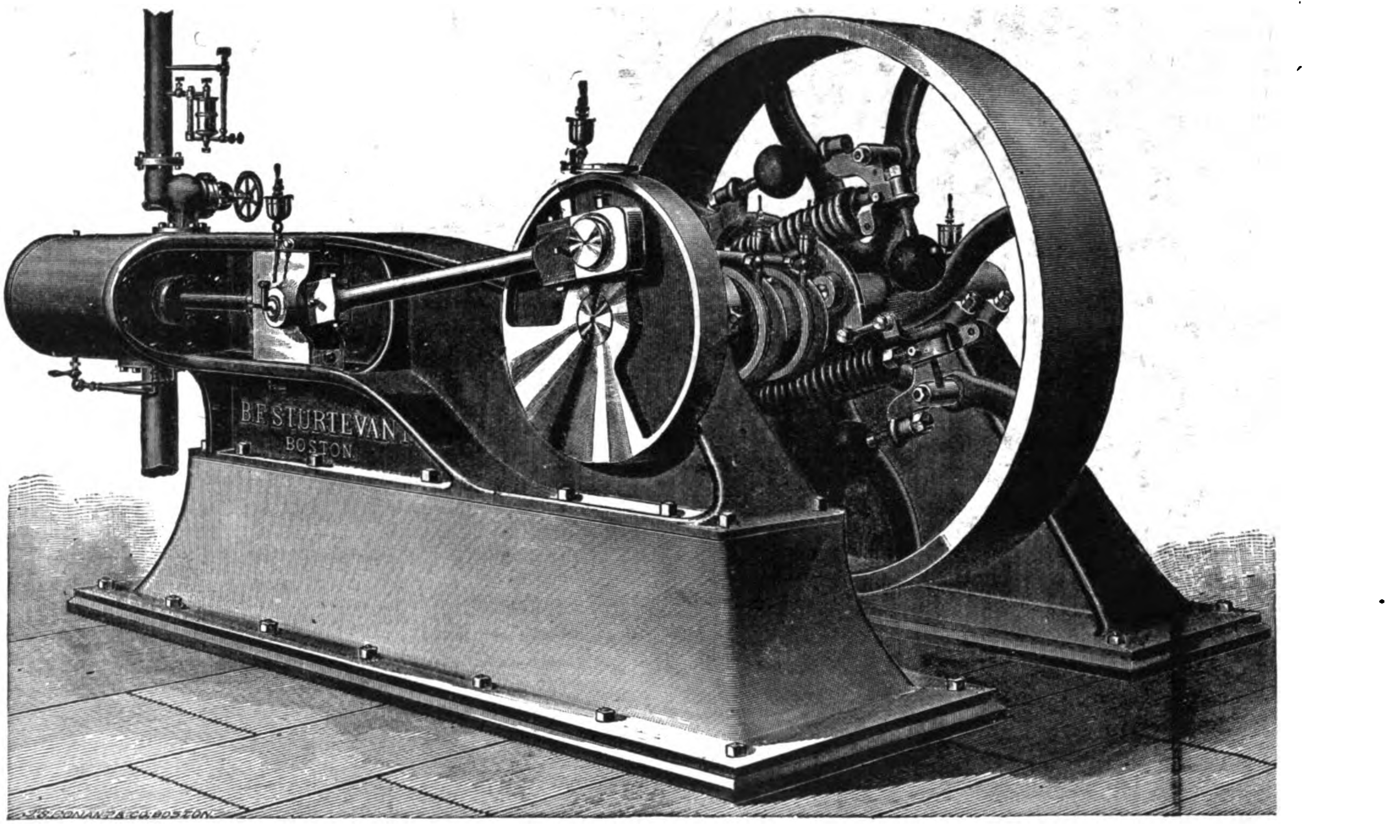


Fig. 52.—DOUBLE-VALVE ENGINE.

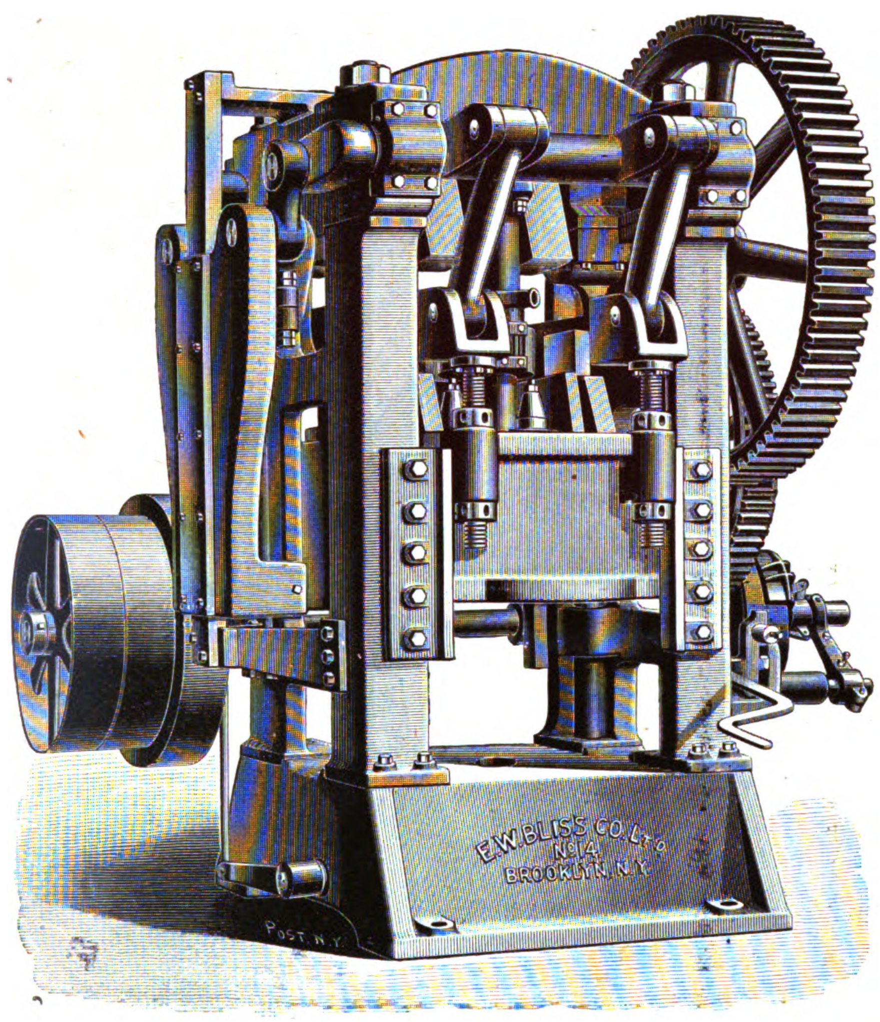
The action of inertia in the moving parts is made by Mr. Porter the means of securing smoothness in working and evenness of crank-pin pressures. At the beginning of the stroke the inertia of the piston, its rod, the cross-head and to a certain extent the connecting-rod, of all reciprocating parts, causes them to offer a certain resistance to the accelerated motion which they are compelled to take up. This resistance becomes less and less up to zero at half-stroke, the point at which their velocity is a maximum. Passing this point, they are rapidly retarded, and this same property of inertia causes them to offer a resistance to retardation, which resistance now is felt as an impelling force at the crank-pin. Thus, the effect of the presence of these heavy masses in the line of connection produces a reduction of pressure upon the pin at the commencement, and an increase of pressure at the end of stroke. But in consequence of the varying action of the steam, producing an excess of pressure at the beginning and a deficiency of pressure at the end of stroke, we may combine these two effects, and the result is a comparatively uniform load upon the crank-pin throughout the stroke. This compensation is capable of being in many cases, very nicely adjusted by properly proportioning the weight of the reciprocating parts. It is evident, however, that at some higher speed, the weight of these parts, as proportioned for strength

(Continued on page 12.)

NEW TOGGLE-DRAWING PRESS.—ABOUT PRESSES.

A representative of the SCIENTIFIC MACHINIST visited the mammoth plant of E. W. Bliss Co., in Brooklyn, N. Y., about Dec. 1st, and not only saw many extremely interesting methods and machines, but is enabled to give our reader the benefit of a portion of what he witnessed, the machine illustrated on this page being one of the latest productions of that celebrated plant.

He says: With a word that may be of interest to many, I will proceed to the description of the machine, the likeness of which I inclose. The E. W. Bliss Co., (Ltd.,) make everything in the line of presses. Illustrations of machines for every kind of work for which a press of any description can be used, can be found in their elegant catalogue of nearly 300 pages, which contains more than a hundred different styles and sizes. This catalogue, I understand, is sent free to any one interested in presses.


E.W. BLISS CO. LTD.
NO. 14
BROOKLYN, N.Y.
POST N.Y.

NEW TOGGLE-DRAWING PRESS.

The frequent and radical improvements which they have been making in drawing presses during the past few years have revolutionized their construction. They have now brought them to a high state of efficiency, which leaves further improvement attainable in minor details only. In the matter of weight and strength of parts, they have increased them until each press, as now constructed, is equal to the next larger size as formerly built. The most important change, however, is the perfecting of an arrangement for operating the blank-holder by means of toggles, which entirely dispense with cams of any description.

Two rock shafts are placed across the back and front of the frame, to which the blank-holder yokes are connected by toggle links. These rock shafts are operated from a crank on the outer end of the main shaft, by a peculiar system of link work, which imparts, through the blank-holder, a much more uniform pressure to the blank than can be maintained in cam-drawing presses. The strain arising from the pressure put upon the blank is transferred through the straightened toggles directly to the frame of the press, instead of falling on the main shaft, thus relieving entirely the bearings from all friction and wear due to the blank holding. Better and smoother work, with fewer wasters, greater durability, and less consumption of power are the principle advantages gained through their toggle movement.

The main frame, of all sizes up to and including No. 5, is made of a single casting, thus imparting great strength and rigidity to the whole structure. The main shaft is of forged steel, with a crank slotted out to operate the plunger. This plunger is guided on the inside of the blank-holder slide and connected to the crank by a pitman with steel adjusting screw, provided with right and left hand ratchet collars for quickly adjusting same. The adjustment of the blank-holder is made by means of four steel screws, as plainly shown in the illustrations.

In the largest sizes, power is communicated to the back shaft through a powerful friction clutch, which, in connection with an automatic brake, places the movements of the press entirely under the control of the operator, so that the press can be stopped and started instantly at any point of the stroke.

Their toggle-drawing press, No. 14, which is here illustrated, is adapted for drawing a large variety of heavy work, including the largest articles made of tin plate, and nearly everything drawn of black iron and steel in the manufacture of enamelled iron ware. It is also used to advantage for drawing kitchen and bath boiler heads, soda fountain cylinders, the smaller sizes of sinks, heavy brass and copper goods, and many other articles of silimar character.

It is much more compact and substantial than presses hitherto put on the market for similar work, more easily adjusted, and operated with less expenditure of power. The wear is reduced to a minimum through the application of the toggle mechanism, which also insure a smoother action and a more perfect "dwell" of the blank holder than can be obtained in "cam" drawing presses. The standards are connected with the die bed below, and a heavy top brace above, by means of four 4¼" steel bolts, which take the main stress of the press action, thus relieving the cast iron parts of the frame from all tensile strain. The movements of this press are under perfect control through the hand lever shown, which actuates a powerful friction clutch and brake. The slides can be instantly stopped, started or held at any point of the stroke.

Further particulars concerning this, or a description of any kind of a press, can be obtained by addressing the E. W. Bliss Co., 135 Plymouth St., Brooklyn, N. Y.

◆

JAY GOULD.

The death of few celebrated men has been less lamented than that of Jay Gould, the robber financier. No more just summing up of his acts can be made, than that of the editor of the Railroad Gazette. He says:

By the death of Jay Gould the socialists and anarchists have lost their mightiest ally. His work has done more for their cause than all the arguments of Marx or the diatribes of Most. It was precisely such work as his that gave those arguments and diatribes whatever force they may have possessed. The essential feature, common to socialism and anarchism, is a protest against modern business methods. Whoever develops those methods in the right direction weakens the socialistic party; whoever develops them in the wrong direction strengthens it. Jay Gould developed business methods in the wrong direction; he brought out their possibilities of evil rather than their possibilities of good. He thereby gave point to the charges of the socialists against our commercial system; and the community, so far as it tolerated his methods and acquiesced in this development, in some measure pleads guilty to the charges. * * * The operations of men like this, in our worst period of commercial abuse, has been told with unrivaled force by Charles Francis Adams in his "Chapters of Erie."

It is fair to say that even in the worst days society was not quite satisfied with transactions of this sort. The men who engaged in them felt this. Some, like Daniel Drew, tried to propitiate public opinion by attendence on prayer meetings and gifts to religious objects. Others, like Fisk, went to the opposite extreme, and set public opinion at defiance, by a career of reckless libertinism. Gould made neither of these mistakes. He neither sought to defy society nor to propitiate it. It may be that he was so interested in the game of money-making that he was actually indefferent to everything else. It may be that he believed that, if he was successful in money-making, society would ultimately condone the means used. If so, he was partly wrong and partly right. Public opinion was never quite ready to pardon some of his worst offenses. * * *

Take the case of the Kansas Pacific transactions, for which Jay Gould has been recently commended by resolution of the directors of the Western Union. What were the leading facts in this case, omitting certain darker side transactions connected with it? Gould bought the stock of a number of small lines at a low figure, made use of his position in the Union Pacific to sell them at an unduly high figure, and thus loaded the Union Pacific with burdens and himself with dollars. Now, if we can get ourselves sufficiently away from our nineteenth century standpoint, let us see what this means. He not only took money from the investors to enrich himself, but he made use of a position of trust to despoil those who had trusted him; and, worse than all this, he was false to the duties of the still wider position of trust which society had given him as a leader in the business of the country. The excuse that he and his associates did not look at things in this way may relieve him of some of the personal blame, but renders the transaction itself all the more dangerous. It is not from avowed lawbreakers like Fisk, whose careers throw odium upon their commercial transactions, that society has most to fear, but from men who maintain a respectability of private character which wins toleration for their breaches of public trust.

◆

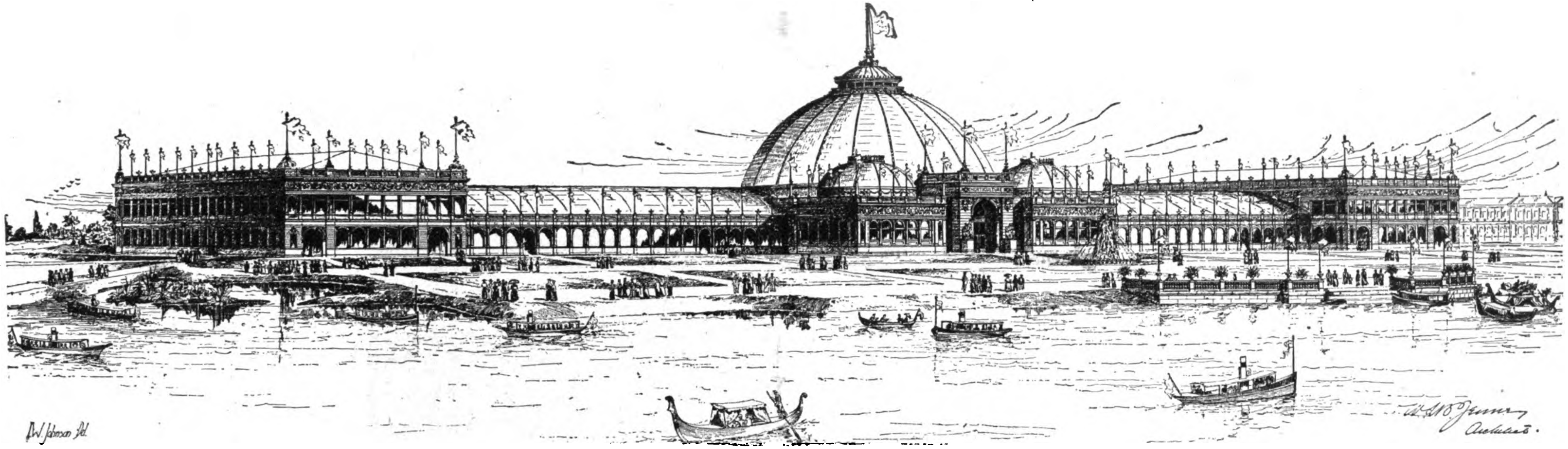
THE Legislature of Minnesota is to be petitioned for permission to use the water power of Minnehaha Falls. The petitioner has looked over the territory about the falls, and says that there is an immense water power going to waste, a power worth $100,000. He thinks that by building a dam above the falls, a huge reservoir could be made to hold the water that is now going over the ledge. From the top of the falls to the mouth of the Minnehaha Creek there is a fall of over 100 feet. He proposes to convey the water from its orignal course to the open ground near the mouth of the creek, either by a tunnel or flume. He would erect the factories in the open place in the glen, at which place he would have his turbine wheels.

◆

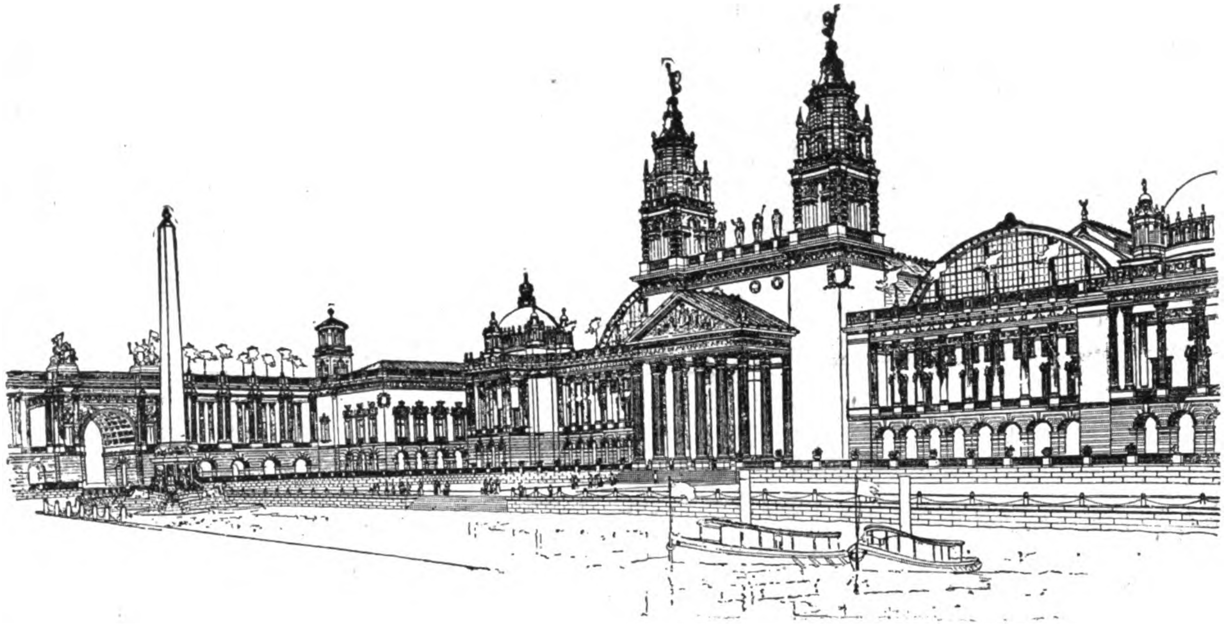
A SYSTEM of ventilating railway cars has been patented in Canada by Major Sam Hughes, M. P., of Lindsay, Ont. This system provides both for the supply of pure air warmed or cooled according to the season, and also for the extraction of the vitiated air from the car.

◆

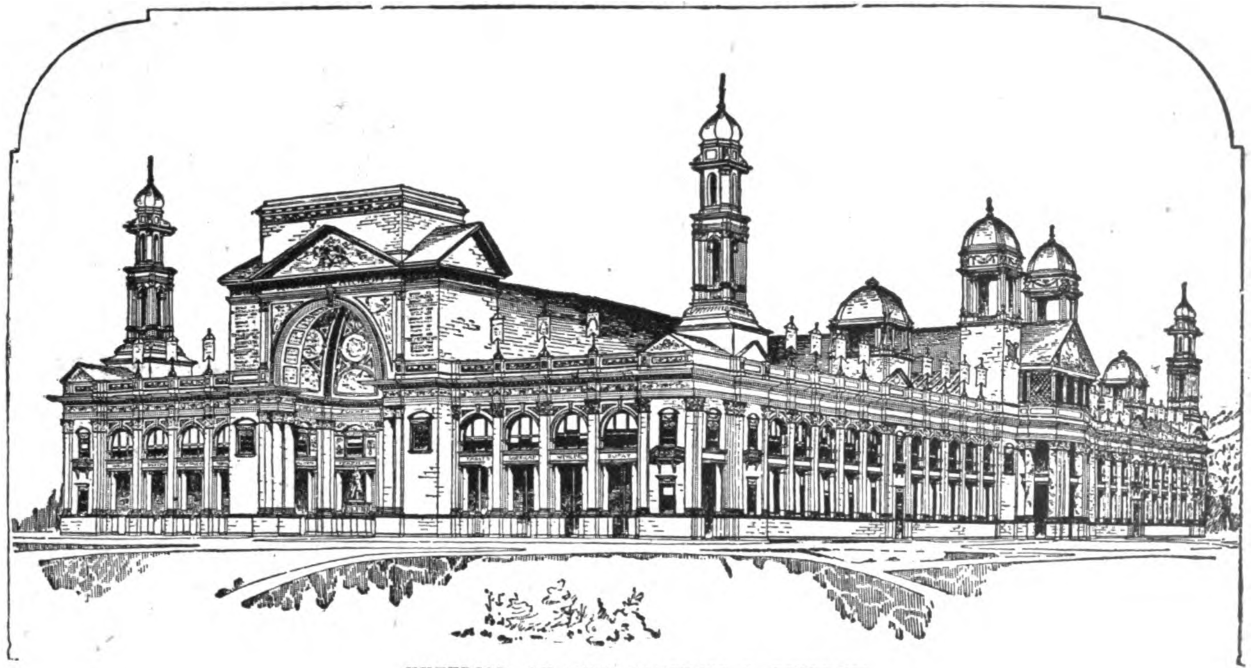
A PETRIFYING process consists of immersing for several day, any object of wood, in a bath, the ingredients of which are rock salt alum. white vinegar, chalk and pebbles pulverized, in equal parts.


A.W. Johnson del.
W. L. B. Jenney Architects

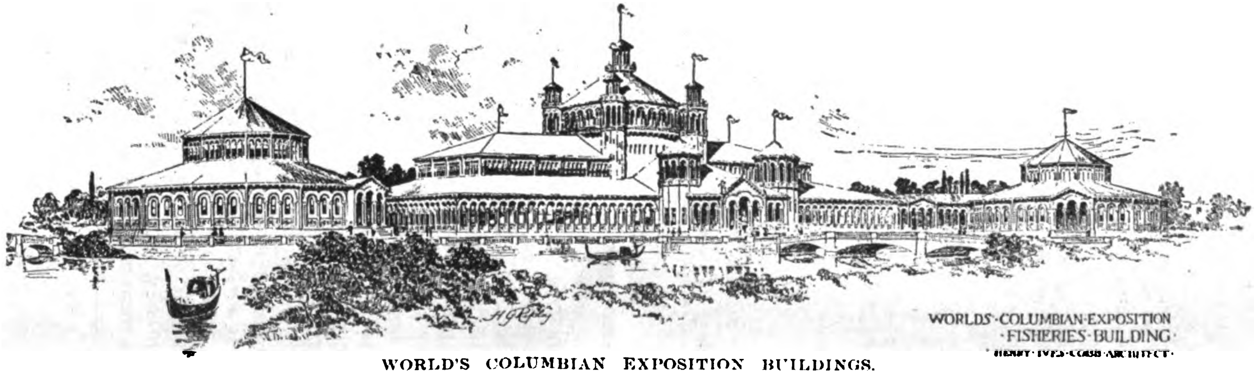
HORTICULTURAL HALL



ANOTHER VIEW OF MACHINERY HALL.



EXTERIOR OF THE ELECTRICAL BUILDING.



WORLD'S COLUMBIAN EXPOSITION BUILDINGS.

STRUCTURE OF THE STEAM-ENGINE.—V.

(Continued from page 9.)

simply, would be sufficient to give this desirable adjustment of the load on the crank-pin. There is no reason to suppose that this, which would seem to be a natural speed of the steam-engine, may not, at any time, be attained.

The Porter-Allen engine, the earliest of the "high-speed" engines, was also one of the first of its class to be constructed as a compound engine. Since the best engines of this type have about the efficiency of good Corliss engines, it is evident that the opportunity offered for economical improvement is here equal, and the result of the experiment has been as satisfactory. The usual methods of compounding are substantially the same as those familiar in the case of the Corliss engine, and they may be expected to exhibit a similar ratio of improvement when compared with the corresponding simple machine. In some cases this gain is not sufficient to compensate the increased cost and complication, added expense of maintenance, and greater weight and volume; but at pressures exceeding sixty or seventy-five pounds it is found that they give real advantage, and the more as the pressures and ratios of expansion are increased. At still higher pressures, as for those exceeding 125 or 150 pounds, it is probable that still further subdivision of the total expansion-ratio, and the construction of the triple-expansion engine, would prove to be an improvement, while at pressures exceeding 200 or 225 pounds the quadruple-expansion machine would be as profitable, comparatively, as in those departments of application in which they have been already set at work. A maximum ratio of expansion of about three in each cylinder is probably advisable.

Another engine of this class is that first designed by Mr. J. W. Thompson, and known as the "Buckeye engine." This engine was not a radical competitor of the pioneer engine; but was, from the beginning, a moderately-high-speed engine. It was fitted with a positive motion, "automatic" or self-adjusting valve-gear, and a balanced valve, and had sufficient stability and excellence of workmanship to make it safe at high speeds; while the peculiarities of its construction were such as gave it a very high place as an economical machine. In this case the cylinder is carried on a pedestal, as is that of the Corliss engine, usually; the frame consists of a girder uniting the cylinder and the main pillow-block and carrying the guides; the crank-shaft end is carried by another pillow-block. The main frame is, however, suppported by a strut which is now usually seen in other engines, and which takes the load tending to spring the girder under the guides.

The valves are so constructed that the steam enters balance-pistons, through which it passes to the interior of the valve, where the boiler-pressure is constantly maintained when the engine is at work. The balance-pistons are packed with sprung rings and followers, and fitted to work steam-tight on faces on the cover-plates of the valve. Coiled steel springs serve to hold the pistons to their seats on the valve when steam is shut off. From the interior of the valve the steam is admitted to the cylinder through ports in its faces as they are alternately brought by its movement to coincide with the cylinder-ports.

The cut-off valve is formed by two plates shown at v v, Fig. 49, rigidly connected by rods h h h′ h′. These plates work on seats surrounding the valve ports, which ports they alternately cover at times relatively to the piston-travel, determined by the governor. The governor is of a type that has not been seen in engines previously described. In the common "fly-ball governor" the two balls revolve about a vertical spindle, to which they are attached by a pair of arms in such a manner that they may take any position that the resultant action of gravity, centrifugal force, and the pull on the supporting arms may give them. A defect common to all governors of this class is that the force tending to pull the balls downward is perfectly uniform. The position taken by the balls, at any fixed speed of engine, is always the same; the connection of the balls with the regulating mechanism is one which always preserves a fixed relation between the position of the governor-balls and the position of the regulating apparatus. Thus it happens that the engine can never be kept precisely at speed, unless the speed is such as will give the governor exactly its normal position and, at the same time, such that the valves shall supply just the normal quantity of steam to the engine. If we can substitute for the action of gravity a force which can be made to vary with change in the position of the balls, in such a way that the variation in the opening of the throttle, or in position of the point of cut-off, shall go on until the engine comes to speed, irrespective of all other conditions, we shall have what is known as an "isochronous" governor, and shall be able to secure the right speed, whatever changes occur in steam-pressure or in load, provided that there is steam enough to drive the load at that speed with the least expansion for which the engine is designed. Such a result can be reached by substituting the tension of a spring, properly set, for the action of gravity. The form of governor here illustrated is, or can be made to be, of this class. It simply requires that the spring tension shall be given a certain easily determined relation to the effort of centrifugal force.

A governor of this character, when well made and adjusted, will open the throttle-valve, or will increase the ratio of expansion, as the steam-pressure diminishes or as the load is increased, and will continue to move in the proper direction indefinitely, or until the machine comes to speed, or until the engine is doing all that it can do. In this governor (Fig. 50) two levers are set on either side the crank-shaft, in a frame or a pulley to which they are pivoted at b, b. These rods carry weights, A, A, which may be adjusted to any desired position by means of the bolts seen in the cut. The outer end of each rod is linked to the loose eccentric, C, C, by the rods B, B, and is controlled by the springs F, F, which resist the effort of centrifugal force tending to throw the weights outward. As the weights swing outward or inward, as the one or the other of the two opposing forces predominates, the eccentric is turned on the shaft in such a manner as to give the valves that motion which is necessary to produce the proper distribution of steam to bring the engine to its speed. The adjustment of this regulator to its work is easily obtained by the shifting of the weights along the levers, or by increasing or diminishing their amount, as is found necessary.

The general arrangement of this system and the appearance of an engine of this class are illustrated in the accompanying engraving.

A dash-pot has sometimes been used on the governor to correct the tendency to violent fluctuations when nearly isochronous, and this was probably the first case of its use on this class of engines.

The independence of the cut-off and main valves, in consequence of the use of two eccentrics, permits any ratio of expansion to be adopted that may be desired, and the fact that the cut-off eccentric is set, at starting, nearly "with the crank," gives a wide range determinable by the governor, nearly from full-stroke to complete suppression. As the governor shifts the eccentric about the shaft, it gives increased angular advance and a shorter and shorter cut-off.

Here the main valve is actuated as in the common forms of valve; but its eccentric, instead of being set ahead of the crank, follows, the exhaust and steam-openings being, by the structure of the valve, reversed, and their acting edges transposed.

By carrying the pivot of the cut-off rock-shaft on the main rock shaft arm, uniform travel of the cut-off valve on the back of the main valve is secured, whatever the variation of cut-off. This insures uniform wear. In this, as in all engines similarly regulated, any mishap to governor or its connections stops the engine, "a run-away engine" being thus impossible.

In some cases, the use of an independent cut-off valve actuated by an "automatic" regulation system is adopted with the simpler forms of valve. The following figure illustrates such a plan, as constructed by Sturtevant, for all powers up to 150 H. P. Here the passages in the main valve, for the admission of steam, do not extend through the entire thickness of the valve. Within the main valve is a cylindrical seat in which runs a piston-valve, which receives from its eccentric a differential movement relatively to that of the main valve, just before the beginning of the stroke, opening the passage into the cylinder. The valve returns to cut off the steam at a time determined by the governor. As, at this time, the two valves are moving in opposite directions, this action is very prompt.

This form of cut-off valve has very little motion in its seat, and is subject to no lateral pressure. The main valve is set to cut off at three-quarters stroke. The main valve is balanced by pressure-plates upon its back.—[From "A Manual of the Steam-Engine," by Thurston, published by John Wiley & Sons,
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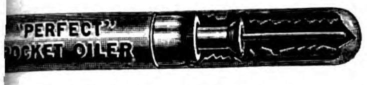

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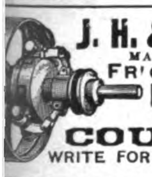

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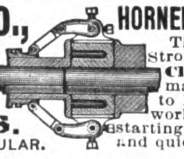

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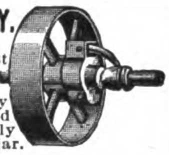

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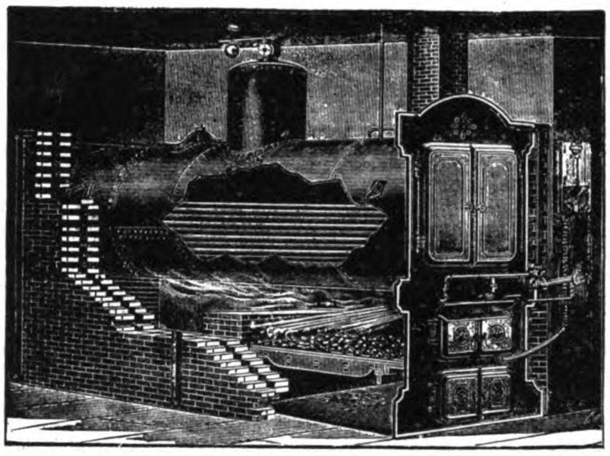

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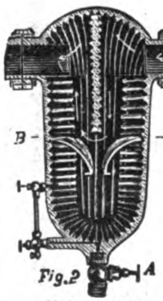

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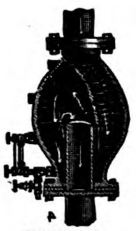

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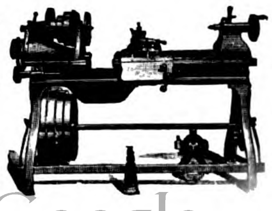

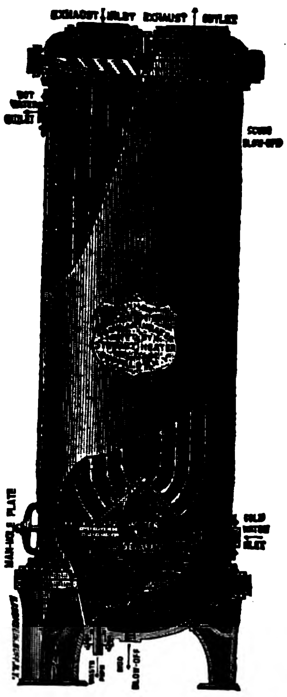

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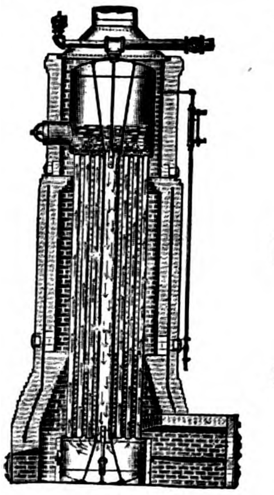

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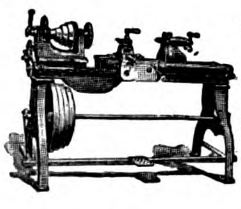

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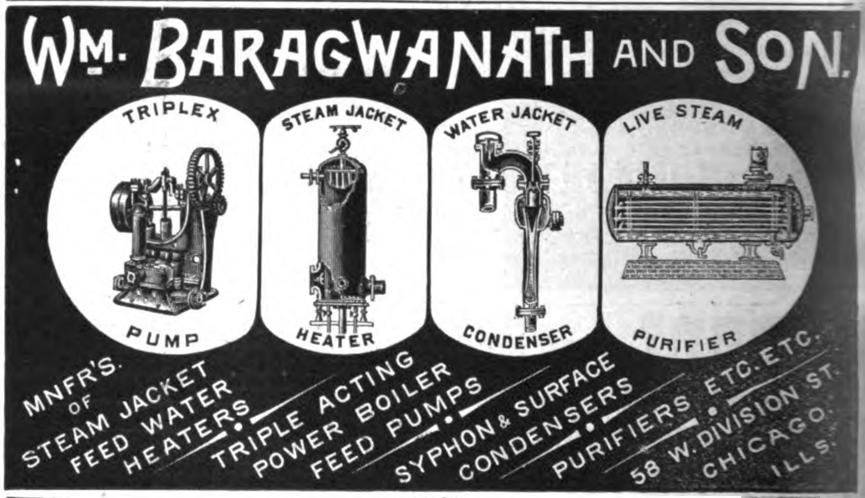
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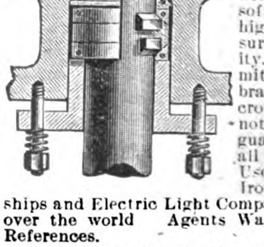

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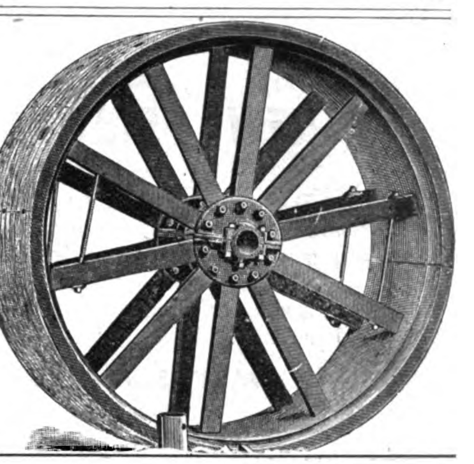

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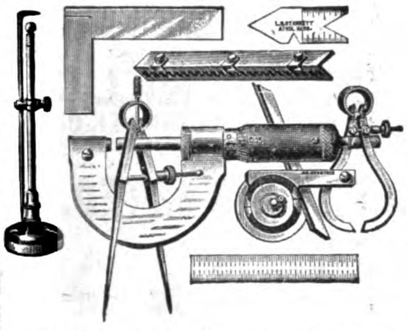

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Depot foot of South Water St.

	Depart.	Arrive.
Valley Junction Mail	*7:25 am	*6:40 pm
Chicago Express	*8:35 am	*0:00 pm
Marietta Express	†11:15 am	†2:35 pm
Balto. & Wash. Express	*4:00 pm	*10:25 am
Cleve. & Canton Express	†6:30 pm	†8:20 am

*Daily. †Daily, except Sunday.

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No. 17 South Western Limited	† 4 20 am
No. 3 Columbus, Cin. & Ind. Ex	7 20 am
No. 23 Wellington Accommodation	6 15 am
No. 7 Columbus & Cincinnati Express	†11 50 am
No. 5 Indianapolis & St. Louis Ex	†12 10 pm
No. 27 Columbus Accommodation	4 00 pm
No. 9 Col., Cin. & Ind. Ex	† 8 15 pm
	Arrive.
No. 8 Cin., Col. & Ind. Ex	† 7 30 am
No. 26 Galion Accomodation	9 30 am
No. 12 Col. & Cin. Express	† 2 30 pm
No. 10 Indianapolis & St. Louis Ex	† 2 05 pm
No. 24 Wellington Accommodation	6 40 pm
No. 2 Col., Cin. & Ind. Ex	7 45 pm
No. 18 South Western Limited	† 1 20 am

Nos. 3, 7, 9 and 17 will run to Cincinnati via Columbus. No. 9, leaving at 8 15 p. m., will have sleeper for Cincinnati and Indianapolis.

Departures from South Water Street station five minutes later and arrivals five minutes earlier than above.

No. 12, 17 and 18 do not stop at South Water St.
†Daily: all trains daily except Sunday.
City Ticket Office, 173 Superior St.

Cleveland, Lorain & Wheeling R. R.

Cleveland Union Station Foot of Bank St.

Direct Line—Through Cars.	Depart.	Arrive.
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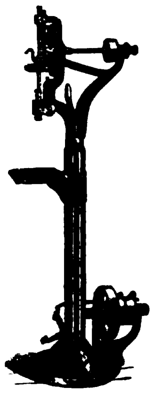

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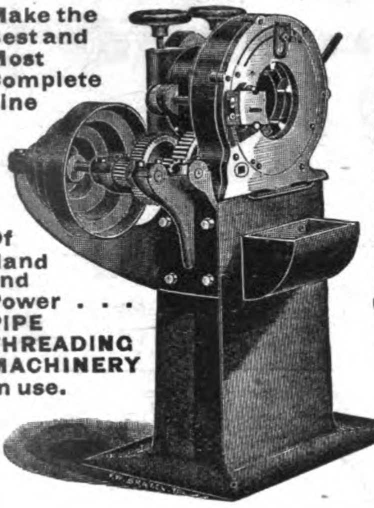

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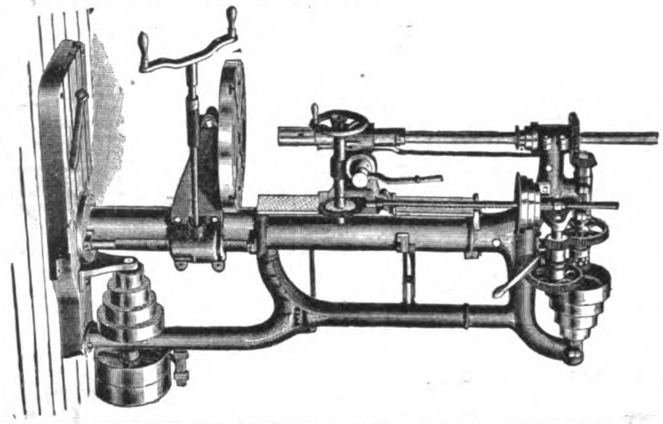

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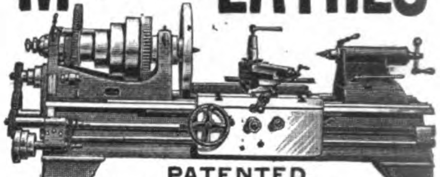

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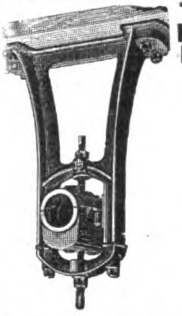

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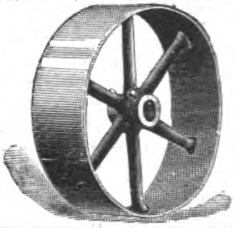

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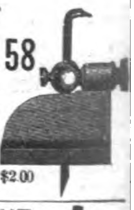

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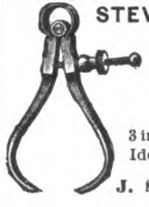

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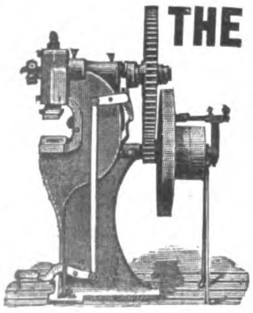

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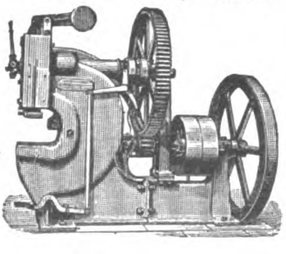

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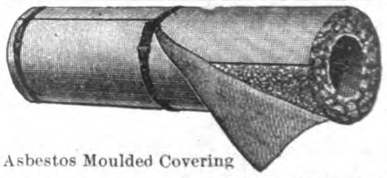

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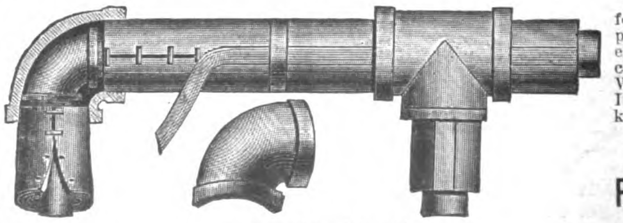

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